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ABSTRACT

Intended to be used as a teaching and learning guide, the basic course of study presented in these materials is designed to provide the essentials of the electrical occupations trade, insuring that the students who successfully complete the course will have sufficient competencies for initial employment and ample orientation for growth and development. The course of study is designed as a 3-year curriculum involving approximately 1,500 hours of class and laboratory instruction. The material has been arranged in major divisions of the trade: (1) Introduction, (2) Wiring Methods, (3) Motor Generators, (4) Motor Control, and (5) Electrical Maintenance. Most of the course material consists of job sheets, which indicate to the student what to do in performing various job assignments, and skill competency sheets, which supplement job sheets and indicate to the student how to perform the manipulative handling of tools and materials that make up the doing part of the occupation. They are simply written and highly illustrated. A cumulative reuse of the skill competencies continues throughout the entire job sheet collection. The job sheets are arranged in an order that gradually exposes the skill competencies to insure the introduction of each operation or skill competency in a controlled manner. Included for use by the teacher are general course objectives, suggested teaching methods and vehicles of instruction, and items for development by the local teacher. Sample information sheets, sample assignment sheets, and a bibliography are included. (HD)

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TRADE AND INDUSTRIAL EDUCATION

COURSE OF STUDY

FOR

ELECTRICAL OCCUPATIONS

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Bureau of Vocational Education
Harrisburg, Pennsylvania

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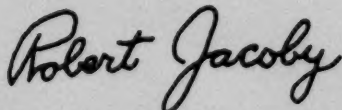
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PREFACE

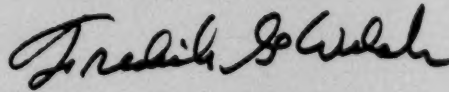
In recent years, we have planned and constructed the finest of vocational education facilities and have placed fine equipment in these facilities. Equal attention must be directed to provide the teacher with the basic tools for instruction to assist in providing quality instruction.

This basic course of study is intended to be used as a teaching and learning guide. The information provides the essentials of the occupation, insuring that the students who successfully complete the course will have sufficient competencies for initial employment and ample orientation for growth and advancement. The teacher who uses this course may find it necessary to modify and supplement the material to meet the needs of specific students and the local industrial community.

This material has been prepared by a committee of teachers under the general direction of the staff and the Division of Occupational and Vocational Studies at The Pennsylvania State University in cooperation with Trade and Industrial Education staff of the Bureau of Vocational Education of the Department of Education.



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1976

COURSE PHILOSOPHY

This course of study in Electrical Occupations is designed to meet the needs of secondary students who seek specilized training in order to enter the labor market. Opportunities will be provided to encourage development of skill, knowledge and attitudes necessary for the student to function on the job, as well as enhance his citizenship qualities.

It is planned that each student may progress at a rate most appropriate for his background, desires and abilities. Those students showing leadership qualities will have the opportunity to exercise and develop those qualities. Group projects will be designed to encourage work cooperation and provide leadership functions. Safety on the job and adherence to good working standards will be a regular consideration. Pride and dignity of work accomplishments will be of utmost importance.

GENERAL COURSE OBJECTIVES

<u>Objectives</u>	<u>Suggested Activities to Achieve Objectives</u>
1. To develop skill, competence, and related information associated with the occupation of electrician.	1. Provide information sheets, operation sheets, job sheets and individual assignment. 2. Give informational instruction. 3. Plan laboratory experiences. 4. Schedule a series of individual jobs.
2. To develop a good labor management relationship.	1. Assign reading in trade magazines. 2. Schedule discussion of labor management problems.
3. To develop skilled craftsmen.	1. Provide specific standards. 2. Provide clean, well-organized classroom and practice area. 3. Provide guidelines for performance in workman-like manner. 4. Provide means for student to practice same.
4. To develop safe working habits.	1. Provide safety organization and instruction. 2. Utilize safety posters and displays. 3. Demonstrate safety practices. 4. Show movies on safety.
5. To develop a cooperative attitude toward others.	1. Provide student planning committee. 2. Set up group projects. 3. Encourage students to help others. 4. Assign advanced students to help others less skilled.
6. To develop leadership ability.	1. Provide student opportunity to plan their own work job. 2. Provide a means for self-appraisal of own work. 3. Encourage membership in V.I.C.A.

PLAN OF INSTRUCTIONAL PRACTICE

The effectiveness of instruction depends on the careful organization and control of the routine details concerning the management of the pupil, equipment, teaching methods and the physical laboratory arrangement. The teacher must determine the best management practices and formulate a very definite statement of the basic standards to be followed in teaching the course to bring about the attainment of the learning goals.

Length of Course

The course of study is designed as a three-year curriculum involving approximately 1500 hours of class and laboratory instruction, primarily for beginning students who are interested in securing employment in the occupation. Where job entry is the goal, the entire course of study would be appropriate. In adults programs, it may be found that a single thrust is the student's goal, therefore, the course content may be restricted to a single major division.

Use of This Course of Study

The material has been arranged in major divisions of the trade. In most cases, the material contained in the first division must be learned before progressing to the next division. The nature of some trade areas permit entry into random divisions after the introductory basic material is covered. Some divisions of the occupation can be taught separately.

The content of this course material consists of job sheets (yellow) and skill competency sheets (white). The skill competency sheets are simply written and highly illustrated. These sheets outline the manipulative handling of tools and materials that make up the doing part of the occupation. The sequence of the skill competency sheets (SC) is based on the organization of the job sheets. Notice that job number one incorporates the basic skill competencies and job number two includes additional skill competencies. This cumulative reuse of the skill competencies continues throughout the entire job sheet collection. After a number of jobs have insured that the student has been sufficiently exposed to a skill competency, no further reference to that skill competency is made.

The job sheets are arranged in an order that gradually exposes the skill competencies. The purpose of the job sheet is to insure the introduction of each operation or skill competency in a controlled manner. Look at this group of jobs as a framework that can be added to, by you, to meet local needs. You may decide to design new or different jobs that will be inserted between or replace any of the suggested jobs. In time you will be able to custom design a course of study for your own needs. There will be little or no need to vary the skill competency sheets.

Teaching Methods

The following procedures are offered as the most productive in achieving the desired results in this course.

1. Demonstrations--Operations and procedures will be demonstrated while the students observe. The purpose is to show how things are done correctly and safely.
2. Class Discussion--A method of teaching in which the students and the teacher take part, directed and controlled by the teacher to a predetermined objective. Technical and related information common to a class or group of students will be presented in this manner. Evaluation of the material presented in this manner should be done by objective testing.
3. Laboratory Talks--Short, informal talks by the instructor during laboratory activities to convey information pertinent to the activity in progress. Not scheduled and not timed, this activity should occur at any appropriate time and for periods of varying duration.
4. Observation and Input--This teacher activity should take place at all times when students are performing psychomotor skills. The purpose is to reinforce a previously given demonstration, class discussion, or laboratory talk, or to update the students' skills by further demonstration and/or further disclosures of technical and related information.

Vehicles of Instruction

The application phase of this course will consist of work assignments kept as close to industrial conditions as a shop situation permits. Job, operation and information sheets will be provided, so that students of different levels of skill and ability can understand them. The students will be encouraged to progress as rapidly as possible, and achieve the standard set for the course. Special attention will be given to the unique student, offering special assistance so that slow as well as fast students may progress at their own rate of speed.

Items for Development by Local Teacher

The following items are peculiar to the local school situation and need to be developed by each local instructor.

- . Standards of attainment required of students
- . Pupil work evaluation and grading
- . Shop controls and regulations
- . Pupil personnel organization
- . Method of tool control
- . Records and forms

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COURSE OUTLINE

Instructional Title: Electrical Occupations

Code: 17.1400

OCCUPATION DESCRIPTION

Organized subject matter and experiences which include theory, laboratory, and shopwork as each relates to planning functions, generating and transmitting electricity, installing and maintaining electrical and communications systems, and equipment and components. Instruction emphasizes practical application of mathematics, the sciences, circuit diagrams and blueprint reading, sketching and other subjects essential to preparation for employment in the electrical occupations.

MAJOR DIVISIONS OF THE OCCUPATION

- I. Introduction
- II. Wiring Methods
- III. Motor Generators
- IV. Motor Control
- V. Electrical Maintenance

Skill Competency Development Jobs

The following is a list of suggested Jobs, assigned by the teacher, to provide experiences for the student to assist him in developing competencies of the Electrical trade. These are Job Titles only. The numbers correspond with the identifying numbers of the Job Sheets that follow.

Note: No student jobs are assigned for Unit I. However, assignment sheets will be available to supplement textbook readings.

Unit II. Wiring Methods

- J-2-1 Cut Wire
- J-2-2 Strip Conductors with a Knife
- J-2-3 Strip Conductors with Wire Strippers
- J-2-4 Twist #14 Two Wire Taps
- J-2-5 Twist #14 Three Wire Taps
- J-2-6 Remove Insulation Leaving A Lead
- J-2-7 Twist #14 Two Wire Taps with Lead
- J-2-8 Twist #14 Three Wire Taps with Lead
- J-2-9 Light a Propane Torch
- J-2-10 Solder #14 Two Wire Taps
- J-2-11 Solder Two #14 Wires with a Soldering Gun
- J-2-12 Tape #12 Conductors
- J-2-13 Tape #14 Conductors with a Lead
- J-2-14 Mount Wall Cases
- J-2-15 Put Drill Bits in a Chuck
- J-2-16 Drill 3/8" Holes in Wood Studs
- J-2-17 Pull 14-2 with Ground Romex
- J-2-18 Staple 12-2 with Ground Romex
- J-2-19 Remove Wall Case Knock-outs (K.O.'s)
- J-2-20 Strip 12-2 with Ground Romex

- J-2-21 Clamp 12-2 with Ground Romex to Wall Cases
- J-2-22 Bend Hooks on #14 Solid Wire
- J-2-23 Connect Solid Wire to Screws
- J-2-24 Install a Duplex Receptacle
- J-2-25 Install 2 Duplex Receptacles
- J-2-26 Install 5 Duplex Receptacles
- J-2-27 Install a Porcelain Light with Pull String
- J-2-28 Install a Single Pole Switch Controlling One Light with Feed to a Switch Box
- J-2-29 Install a Single Pole Switch Controlling Two Lights with Feed to a Switch Box
- J-2-30 Install a Single Pole Switch Controlling One Light with a Feed to the Light Box
- J-2-31 Install a Single Pole Switch Controlling Two Lights with a Feed to the Light Box
- J-2-32 Install a Single Pole Switch Controlling Three Lights with a Feed to the End Light Box
- J-2-33 Install a Single Pole Switch with Pilot Light Controlling One Light with a Feed to the Switch Box
- J-2-34 Install Two Lights on the same Circuit -- Each Light Controlled by its Own Single Pole Switch
- J-2-35 Install Two Lights Controlled by a Dimmer Switch with Feed to the Light
- J-2-36 Install Five Receptacles on the same Circuit and Switch One Receptacle
- J-2-37 Install Three Receptacles and Switch the Top Half of the First Receptacle
- J-2-38 Install One Light Controlled by Two Three-way Switches with Feed to the Switch
- J-2-39 Install One Light Controlled by Two Three-way Switches with Feed to the Light
- J-2-40 Install One Light Controlled by Two Three-way Switches with Feed to the Switch

- J-2-41 Install Four Duplex Receptacles on the same Circuit
- J-2-42 Install a Single Pole Switch Controlling Two Lights with a Feed to the Switch Box
- J-2-43 Install Five Receptacles with Two Three-way Switches Controlling the Top Half of Two Receptacles
- J-2-44 Install a 175 Watt Mercury Vapor Light
- J-2-45 Install a Recessed Light Controlled by Two Three-way Switches
- J-2-46 Install a Fan Controlled by a Single Pole Switch
- J-2-47 Install Two Fluorescent Lights Controlled by Two Three-way Switches
- J-2-48 Install One Light Controlled by Two Three-way Switches and One Four-way Switch with Feed to the Switch
- J-2-49 Install One Light Controlled by Two Three-way Switches and Two Four-way Switches with Feed to the Switch
- J-2-50 Install One Light Controlled by Two Three-way Switches and One Four-way Switch with Feed to the Light
- J-2-51 Install a Delayed Switch Controlling One Light with Feed to the Switch.
- J-2-52 Install One Light Controlled by Two Three-way Switches using B.X. Cable with the Feed to the Light
- J-2-53 Install Five Receptacles in a Sheet Rock Wall
- J-2-54 Install Two Fluorescent Lights Controlled by One Single Pole Switch; Switch Installed in a Sheet Rock Wall
- J-2-55 Install a 100 Ampere Service to the Side of a House (Fuse Box)
- J-2-56 Install a 100 Ampere Service to the Side of a House (100 Ampere Circuit Breaker Box)
- J-2-57 Install a 200 Ampere Service to the Side of the House (Fuse Box)
- J-2-58 Install a 100 Ampere Trailer Service
- J-2-59 Install a Surface Mount Dryer Outlet
- J-2-60 Install a Recessed Dryer Outlet
- J-2-61 Install a Surface Mount Range Outlet
- J-2-62 Install a Recessed Range Outlet
- J-2-63 Install Two Flood Lights Controlled by a Photo Cell Switch

- J-2-64 Install Baseboard Heat and Hook Up Power
- J-2-65 Install Baseboard Heat and Mount the Thermostat on the Wall
- J-2-66 Install Electric Heat in Two Rooms on the same Circuit
- J-2-67 Install Two Sections of Electric Heat Butted Together; with a Thermostat Mounted on the Wall
- J-2-68 Install a Bathroom Heater and Hook Up the Power
- J-2-69 Install 5 Receptacles on the same Circuit using Conduit
- J-2-70 Install 2 Three-way Switches Controlling One Light with $\frac{1}{2}$ " Conduit
- J-2-71 Install Two Flood Lights Controlled by a Time Switch
- J-2-72 Install a Door Bell Controlled from One Point
- J-2-73 Install a Door Bell Controlled from Two Points
- J-2-74 Install a Door Bell Controlled from Three Points
- J-2-75 Install a Manual Annunciator
- J-2-76 Install an Automatic Annunciator

Unit III. Motor Generators

- J-3-1 Connect and Operate a Separate Excited D.C. Shunt Generator
- J-3-2 Wire and Load a Separate Excited D.C. Shunt Generator
- J-3-3 Connect and Operate a Self Excited D.C. Shunt Generator
- J-3-4 Wire and Load a Self Excited D.C. Shunt Generator
- J-3-5 Wire and Load a D.C. Series Generator
- J-3-6 Wire and Load a D.C. Compound Generator
- J-3-7 Wire and Operate a D.C. Shunt Motor
- J-3-8 Wire and Load a D.C. Shunt Motor
- J-3-9 Wire and Operate a D.C. Series Motor
- J-3-10 Wire and Load a D.C. Series Motor
- J-3-11 Wire and Operate a D.C. Compound Motor
- J-3-12 Wire and Load a D.C. Compound Motor
- J-3-13 Connect and Operate an Alternator

- J-3-14 Connect a Synchronous Alternator to a Power System
- J-3-15 Install, Connect and Operate a Polyphase Motor
- J-3-16 Install, Connect and Operate a Wound Rotor Motor
- J-3-17 Install and Connect a Split Phase Induction Motor, Capacitor Start
- J-3-18 Install and Connect a Shaded Pole Induction Motor
- J-3-19 Install and Connect a Universal Motor
- J-3-20 Install and Determine the Efficiency of a Basic Transformer
- J-3-21 Install, Wire and Operate Two Single Phase Transformers in Parallel
- J-3-22 Install and Connect Three Single Phase Transformers to Delta-Delta
- J-3-23 Install and Connect Three Single Phase Transformers to Delta-Wye
- J-3-24 Install and Connect Three Single Phase Transformers to Wye-Wye
- J-3-25 Install and Connect Three Single Phase Transformers to Wye-Delta
- J-3-26 Install and Connect Three Single Phase Transformers to Open Delta

Unit IV. Motor Control

- J-4-1 Draw Various Equipment, Symbols and Diagrams Used in Motor Control Circuits
- J-4-2 Draw Motor Control Circuits Using Proper Symbols
- J-4-3 Wire a Single Phase, Single Station Motor Control System
- J-4-4 Wire a Single Phase Hand-off-auto Motor Control System
- J-4-5 Wire a Multiple Push-button Station Motor Control System, Single Phase
- J-4-6 Wire a Sequence (A or B) Control Motor Control System, Single Phase
- J-4-7 Wire a Time-Delay Low-Voltage Release, Motor Control System, Single Phase
- J-4-8 Wire Other Motor Control Systems, Single Phase, Using:
 - A. Timing Relays
 - B. Pressure Switches
 - C. Float Switches
 - D. Limit Switches
 - E. Solenoid Valves
 - F. Temperature Switches

- J-4-9 Wire a Motor Controller for a Two-speed, Two-winding Motor, Three Phase
- J-4-10 Wire a Two-speed, One-winding Motor Controller, Three Phase
- J-4-11 Wire a Four-speed, Two-winding Motor Controller, Three Phase
- J-4-12 Wire a Forward-reverse Motor Control System for Three Phase
- J-4-13 Wire an Across-The-Line Starting Controller for D.C.
- J-4-14 Wire a Magnetic Time Limit Controller for D.C.
- J-4-15 Wire a Voltage-drop Acceleration Controller for D.C.
- J-4-16 Wire a Series Relay Acceleration System for D.C.
- J-4-17 Install and Wire Other Control Circuits of D.C. Control Using:
 - A. Jog or Inch Control
 - B. Plugging Control
 - C. Electric Braking Control
 - D. Dynamic Braking Control

Unit V. Electrical Maintenance

- J-5-1 Perform Maintenance on a Defective Fluorescent Fixture
- J-5-2 Perform Periodic Maintenance on a Motor
- J-5-3 Perform Periodic Maintenance on an Emergency Lighting System
- J-5-4 Check and Perform Maintenance on an Electrical Operated Overhead Door
- J-5-5 Perform Periodic Maintenance on an Elevator
- J-5-6 Perform Maintenance on a Control Unit of an Electric Sign
- J-5-7 Perform Maintenance on an Emergency Lighting System (Batt.)
- J-5-8 Perform Maintenance on an Escalator
- J-5-9 Perform Maintenance on Various Lighting Systems
- J-5-10 Perform Maintenance on an Electrical Furnace (Induction)
- J-5-11 Perform Maintenance on an Electric Furnace (Dielectric)
- J-5-12 Troubleshoot and Repair a Faulty Hot Water Heater
- J-5-13 Develop a Complete Maintenance Program with Individual Reports for Each Machine and Other Electrical Devices Used within the School

SKILL COMPETENCIES AND INFORMATION LESSONS

The left hand column lists the tasks of the occupation which form the skill competencies required of the student. These competencies should be demonstrated by the teacher and practiced by the student.

The information lessons outline the general technical information and knowledge needed to perform the skill competencies. These items represent a common information taught on a group instruction basis. Additional information will emerge to be taught on an individual student basis as pupils work on the skill competencies.

The numbers preceding each title correspond to the identifying numbers of the operation sheets and the information sheets. The information lessons relate to the particular major unit of instruction but do not necessarily relate to corresponding skill competency numbers.

Unit I. Introduction

<u>Skill Competencies/Operations</u>	<u>Information Lessons</u>
	IL-1-1 History and Ethics of the Trade
	IL-1-2 School and Shop Procedures
	IL-1-3 Identification of Hand Tools
	IL-1-4 Identification of Power Tools
	IL-1-5 Shop Safety
	IL-1-6 Identification of Basic Trade Drawings

Unit II. Wiring Methods

Skill Competencies/Operations		Information Lessons	
SC-2-1	Cut Wire	IL-2-1	National Electric Code (NEC) Requirements
SC-2-2	Strip a Conductor with a Knife	IL-2-2	Wall Case Alignment
SC-2-3	Strip Wire with Wire Strippers	IL-2-3	Duplex Receptacle Connections
SC-2-4	Twist a Tap (2 Wire)	IL-2-4	Receptacle Circuits
SC-2-5	Twist a Three Wire Tap	IL-2-5	Grounding a Wall Case
SC-2-6	Remove Insulation Leaving a Lead	IL-2-6	Single Pole Switches
SC-2-7	Twist a Two Wire Tap with a Lead	IL-2-7	Series Circuits
SC-2-8	Twist a Three-wire Tap with a Lead	IL-2-8	Circuits used with Single Pole Switches, Power to the Switch
SC-2-9	Light a Soldering Torch	IL-2-9	Circuits used with Single Pole Switches, Power to the Light
SC-2-10	Solder Connections with a Pencil Tip Propane Torch	IL-2-10	Application of NEC Tables and Charts
SC-2-11	Solder Connections with a Solder Gun	IL-2-11	Application of NEC Rules and Regulations
SC-2-12	Taping Conductors	IL-2-12	Parallel Circuits
SC-2-13	Tape a Connection with a Lead	IL-2-13	Series - Parallel Circuits
SC-2-14	Mount a Side Bracket Wall Case	IL-2-14	Circuits used with Single Pole Switches, 3 Lights, 1 Switch, Power to the Switch
SC-2-15	Putting Drill Bit in a Drill Motor Chuck	IL-2-15	Circuits used with Single Pole Switches, 3 Lights, 1 Switch, Power to the Light
SC-2-16	Drill Holes in Wood Studs for Romex, using a Portable Drill	IL-2-16	Circuits used with Single Pole Switches, 4 Lights, 4 Switches, Each Light Controlled by its own Switch, all on the same Circuit
SC-2-17	Install Cable	IL-2-17	Circuits used with Single Pole Switches, 1 Switch, 5 Receptacles, Switch only Controlling First Receptacle, and the other 4 Being Hot all the Time with Power at the First Receptacle
SC-2-18	Anchor Wire by using Staples		
SC-2-19	Remove a Knockout (K.O.)		

Skill Competencies/Operations		Information Lessons	
SC-2-20	Strip Romex	IL-2-18	Circuits used with Single Pole Switches; 1 Switch, 5 Receptacles, Switch to Control all 5 Receptacles with Power at the First Receptacle
SC-2-21	Clamp Cable to Wall Case		
SC-2-22	Bend a Hook Eye on Wire		
SC-2-23	Connect Devices using Screws	IL-2-19	Circuits used with Three-way Switches; 1 Light, 2 Three-way Switches with Feed at the Light
SC-2-24	Install Ground Splice Caps	IL-2-20	Circuits used with Three-way Switches; 1 Light, 2 Three-way Switches with Power at the Light
SC-2-25	Install a Light Bar Hanger		
SC-2-26	Install Wire Nuts	IL-2-21	Installing a Four-way Switch
SC-2-27	Break off Connecting Links on a Duplex Receptacle Making a Split Circuit Outlet	IL-2-22	Installing a Four-way Switch, 2 Three-ways, 1 Four-way, 1 Light with Power to a 3-way Switch
SC-2-28	Remove a Knockout	IL-2-23	Installing a Four-way Switch; 2 Three-way, 1 Four-way, 1 Light with Power at Light
SC-2-29	Install Connectors	IL-2-24	Selection of Service Entrance Cable
SC-2-30	Cut B.X. Cable		
SC-2-31	Strip B.X. Cable	IL-2-25	Installing a Service Entrance
SC-2-32	Install an Anti-short	IL-2-26	Circuit Protection with Plug Fuses
SC-2-33	Cut a Hole for a Wall Case		
SC-2-34	Install Box Holders	IL-2-27	Construction and use of Cartridge Fuses
SC-2-35	Cut Large Cable or Wire	IL-2-28	Grounding Service Entrance
SC-2-36	Strip Cable	IL-2-29	Circuit Breaker Principles, Construction and uses
SC-2-37	Measure and Mark a Line		
SC-2-38	Braid Neutral Wire	IL-2-30	Installation of Wire into the Lugs of a Meter Socket
SC-2-39	Install a Weatherhead	IL-2-31	Ohm's Law, Voltage Computations
SC-2-40	Strap Cable or Conduit to Wood or Wood Products	IL-2-32	Ohm's Law, Current Computations
SC-2-41	Install Wood Screws	IL-2-33	Ohm's Law, Resistance Computations

Skill Competencies/Operations		Information Lessons	
SC-2-42	Install Plastic Anchors	IL-2-34	Voltage Measurements using a Voltmeter
SC-2-43	How to Install Weatherproof Connectors	IL-2-35	Current Measurements using an Ammeter
SC-2-44	How to Seal Weatherproof Connectors	IL-2-36	Resistance Measurements using an Ohmmeter
SC-2-45	How to Install Wire in Lugs	IL-2-37	Continuity Test Requirements
SC-2-46	Place Tubing in Vise	IL-2-38	Checking for Continuity
SC-2-47	Cut Tubing or Pipe	IL-2-39	Checking Single Pole Switches for Continuity
SC-2-48	How to Place Conduit in a Bender	IL-2-40	Checking Three-way Switches for Continuity
SC-2-49	Install Set Screw Conduit Connectors	IL-2-41	Checking Fuses with a VOM
SC-2-50	Install Compression-type Conduit Connectors	IL-2-42	Checking Circuits for Continuity with a VOM
SC-2-51	Hold the Conduit Bender or Hickey	IL-2-43	Determining the Number of Conductors Permitted in Wall Cases, Ceiling Boxes or Junction Boxes (NEC)
SC-2-52	Bend an Offset in Conduit up to 1" in Diameter	IL-2-44	Computing the Number of Outlets Per Circuits (NEC)
SC-2-53	Bend an exact 90° Stub	IL-2-45	Connecting 240v and 120v Lines to a Main Circuit Breaker Panel
SC-2-54	Bend a Kick	IL-2-46	Connecting 120v and 240v Lines to a Main Fuse Box
SC-2-55	Cut Rigid Conduit	IL-2-47	Connecting an Electric Clothes Drier
SC-2-56	Ream Rigid Conduit	IL-2-48	Installing Baseboard Electric Heat
SC-2-57	Thread Rigid Conduit	IL-2-49	Connecting an Electric Hot Water Heater
SC-2-58	Install Rigid Couplings	IL-2-50	Electric Wiring Symbols
		IL-2-51	Construction of a Simple Cell
		IL-2-52	Door Chime Transformers
		IL-2-53	Annunciator Systems

Unit III. Motor Generators

Skill Competencies/Operations		Information Lessons	
SC-3-1	Alignment	IL-3-1	Atomic Theory and the Hydrogen Atom
SC-3-2	Prony Brake	IL-3-2	Development of Static Electricity
SC-3-3	Prony Brake Operation	IL-3-3	Attraction and Repulsion
SC-3-4	Prony Brake Usage	IL-3-4	Construction of a Mechanical Generator
SC-3-5	Using the Tachometer	IL-3-5	Magnetism Fundamentals
SC-3-6	Connect a Starting Rheostat to a D.C. Motor	IL-3-6	Magnetic Fields Displayed
SC-3-7	Reverse a D.C. Motor	IL-3-7	Construction of Electromagnets
SC-3-8	Connect a Dynamic Brake to a D.C. Motor	IL-3-8	Construction of a D.C. Generator
SC-3-9	Insert a Field Rheostat in a D.C. Shunt Generator	IL-3-9	Magnetic Fields Cut by a Conductor
		IL-3-10	Number of Poles, Speed and Conductors
		IL-3-11	Commutating Poles
		IL-3-12	Flemmings' Rule
		IL-3-13	Armature Reactions
		IL-3-14	Handing of Armatures
		IL-3-15	D.C. Motor Construction
		IL-3-16	Half-wave Rectifiers
		IL-3-17	Full-wave Rectifiers
		IL-3-18	Rectification Wave Shapes
		IL-3-19	Watt and the Horse Power
		IL-3-20	A D.C. Motor and its Usage
		IL-3-21	Overcurrent Protection Devices in Motor Circuits
		IL-3-22	Undervoltage Protection Devices in Motor Circuits
		IL-3-23	Capacitor Theory, Description, Use

Skill Competencies/Operations	Information Lessons
	IL-3-24 Electrical Degrees, Explanation and Use
	IL-3-25 Number of Poles vs. R.P.M.
	IL-3-26 The Left Hand Rule for Motors
	IL-3-27 Counter E.M.F. - Lenz-Law
	IL-3-28 Inductance
	IL-3-29 Induction using a Permanent Magnetic Field
	IL-3-30 Induction through Transformer Action
	IL-3-31 Induction Controls
	IL-3-32 The Henry
	IL-3-33 Phase Principles
	IL-3-34 Phase Angle
	IL-3-35 Impedance
	IL-3-36 Coulomb's Law
	IL-3-37 Power Factor
	IL-3-38 Vectors
	IL-3-39 Terminology
	IL-3-40 Definitions
	IL-3-41 Iron-core Transformer
	IL-3-42 Turns vs. Ratio
	IL-3-43 Mutual Inductance
	IL-3-44 Transformer Losses
	IL-3-45 Auto Transformer
	IL-3-46 Lines of Force and Flux Linkage

Unit IV. Motor Control

Skill Competencies/Operations		Information Lessons	
SC-4-1	Develop a Material List	IL-4-1	Explanation of Motor Control Symbols
SC-4-2	Develop and Interpret a Work or Job Sheet	IL-4-2	National Electrical Code Requirements
SC-4-3	Select and Inspect Proper Type of Equipment to be used for Job	IL-4-3	General Principles of Motor Control Wiring
SC-4-4	Layout and Measure Equipment Positions	IL-4-4	Types of Motor Control Devices
SC-4-5	Fasten Equipment using Proper Types of Fasteners	IL-4-5	Circuit Layouts and Connections
SC-4-6	Layout Wire Runs	IL-4-6	Motor Control Protection
SC-4-7	Select and Measure Proper Wire Size	IL-4-7	Circuit Control with a Thermocouple
SC-4-8	Shape and Bend Wire	IL-4-8	Circuit Control with a Photoelectric Cell
SC-4-9	Make Proper Electrical Connections	IL-4-9	Types of Single Phase Control
SC-4-10	Make and Tape Proper Types of Splices	IL-4-10	Types of Three Phase Control
SC-4-11	Check Complete System by a Schematic Diagram	IL-4-11	Types of Direct Current Control
		IL-4-12	Methods of Decelerations
		IL-4-13	Types of Motor Drives
		IL-4-14	Reading a Motor Control Print

Unit V. Electrical Maintenance

Skill Competencies/Operations		Information Lessons	
SC-5-1	Test a Circuit with a Trouble Lite	IL-5-1	Preventative Maintenance Practices
SC-5-2	Test a Circuit with a Voltmeter	IL-5-2	Duties and Responsibilities of Electrical Maintenance Inspector
SC-5-3	Test a Circuit with an Ohmmeter	IL-5-3	Visual Inspection of Electrical Equipment
SC-5-4	Use a Clamp-type Volt-Ammeter in a Service Installation	IL-5-4	Lubrication
SC-5-5	Use a Clamp-type Volt-Ammeter in a Motor Installation	IL-5-5	The Law of Inverse Square
SC-5-6	Troubleshoot a Relay with a Clamp-type Volt-Ammeter	IL-5-6	Fluorescent vs. Filament Lights
SC-5-7	Measure Insulation Quality using an Insulation Tester	IL-5-7	Use of a Megger
SC-5-8	Check an Armature with a Growler	IL-5-8	Bearings and Oil Seals
SC-5-9	Check a Stator with a Growler	IL-5-9	Friction and Anti-Friction Bearings
SC-5-10	Use a Tachometer on a Motor	IL-5-10	Belts, Gears and Pinions
SC-5-11	Check a Motor with a Vibration Indicator	IL-5-11	Motor Service Record
SC-5-12	Set-up a Wheatstone Bridge and find the Distance to a Fault in a Phone Line		
SC-5-13	Set-up a Recorder on an Electrical Circuit		
SC-5-14	Check for adequate Illumination with a Foot-Candle Meter		

WRITTEN INSTRUCTIONAL AIDS

Introduction

Instruction sheets are aids used in developing the most effective and efficient teaching-learning situation that is possible. Four types of sheets are generally used including job sheets, operation sheets, information sheets and assignment sheets.

The Job involves a sequential performance of operations by the learner to "tryout" and develop the skill competencies (operations) of the occupation resulting in a product or service. It is the vehicle of instruction or the media by which the student practices and develops a series of skill competencies (operations). JOB SHEETS indicate to the student what to do in performing the various jobs assigned by the instructor. The jobs that will be used as vehicles of instruction in the course are listed in the COURSE OUTLINE section.

OPERATIONS are the subdivisions in the breakdown of a job. Each operation represents a process, way of doing or how to perform the particular skill competency or operation.

OPERATION SHEETS supplement the job sheets and indicate to the student how to perform the many skill competency operations necessary to complete the assigned jobs. The operations that will be taught in the course are listed in the COURSE OUTLINE section under skill competencies/operations. The operation sheets should be numbered to correspond with the Skill Competencies listed in the course outline.

INFORMATION SHEETS supplement the job sheets and provide the student with information necessary for completing the assigned jobs with highest possible degree of understanding. The information units that will be stressed in the course are listed in the course outline under information lessons. The information sheets included in this section should be numbered to correspond with the Information Lessons listed in the course outline.

ASSIGNMENT SHEETS supplement the job sheets and provide the student with mental activities necessary to learn the "knowing" that accompanies the "doing" of a trade. The student is assigned related studies or technical information to be "sought out" by the student on an individual basis through the use of problems or "exercises".

JOB: Cut Wire

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: (15") #14 TW Solid Wire
(15") #12 TW Solid Wire
(15") #10 TW Solid Wire

TOOLS: 7" Side Cutters
12' Steel Tape Rule

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-1

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut each of the 15" pieces of wire into about 1/2" lengths.	. SC-2-1

METHOD OF EVALUATION:

Observation of the student doing job.

JOB: Strip Conductors with a Knife

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-2

COURSE: Electrical Occupations

MATERIAL: 105" No. 12 TW Solid Wire

TOOLS: 7" Side Cutters
Pocket Knife
12' Steel Tape Rule

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut 15 pieces of #12 TW wire about 7" long.	. SC-2-1
2. Strip about 1 1/4" of insulation from each end of each conductor.	. SC-2-2

METHOD OF EVALUATION:

Observation of the student doing job, also making sure copper wire is not nicked.

JOB: Strip Conductors With Wire Strippers

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-3

COURSE: Electrical Occupations

MATERIAL: 105" No. 12 TW Solid Wire

TOOLS: 7" Side Cutters
Wire Strippers
12' Steel Tape Rule

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut 15 pieces of No. 12 TW wire about 7" long.	. SC-2-1
2. Strip about 1 1/4" of insulation from each end of each conductor.	. SC-2-3

METHOD OF EVALUATION:

Observation of the student doing job.

JOB: Twist #14 Two Wire Taps,
UNIT II: Wiring Methods
COURSE: Electrical Occupations
MATERIAL: 105" #14 TW Solid Wire
TOOLS: 7" Side Cutters
Wire Strippers
12' Steel Tape Rule

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-4

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut the wire into 15 7" pieces.	. SC-2-1
2. Strip about 1 1/4" of insulation from each end of each conductor.	. SC-2-3
3. Twist a two wire tap on each end of each pair of wires.	. SC-2-4

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Twist #14 Three Wire Taps

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: 21' #14 TW Solid Wire

TOOLS: 7" Side Cutters
Wire Strippers
12' Steel Tape Rule

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-5

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Cut the wire into 36 7" pieces.	. SC-2-1
2. Strip about 1 1/4" of insulation from each end of each wire.	. SC-2-3
3. Twist a three wire tap on each end of each group of three wires.	. SC-2-5

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Remove Insulation Leaving a Lead

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: 14' #12 TW Solid Wire

TOOLS: Pocket Knife
12' Steel Tape Rule

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-6

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Cut the wire into 14 12" pieces.	. SC-2-1
2. Remove about 1 1/4" of insulation leaving a 7" lead.	. SC-2-6

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Twist #14 Two Wire Taps With Lead

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-7

COURSE: Electrical Occupations

MATERIAL: 38' # 14 TW Solid Wire

TOOLS: 7" Side Cutters
Wire Strippers
12' Steel Tape Rule
Pocket Knife

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut the wire into 25 12" pieces and 25 6" pieces.	. SC-2-1
2. Strip 1 1/4" of insulation from one end of each of the 6" pieces.	. SC-2-3
3. Strip 1 1/4" of insulation from the 12" pieces leaving a 6" lead.	. SC-2-6
4. Twist two wire taps with 6" leads.	. SC-2-7

METHOD OF EVALUATION:

The instructor will check the finished job.

JOB: Twist #14 Three Wire Taps With Lead
UNIT II: Wiring Methods
COURSE: Electrical Occupations
MATERIAL: 40' #14 TW Solid Wire
TOOLS: 7" Side Cutters
Wire Strippers
12' Steel Tape Rule
Pocket Knife

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-8

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut the wire into 20 12" pieces and 40 6" pieces.	. SC-2-1
2. Strip 1 1/4" of insulation from one end of each of the 6" pieces.	. SC-2-3
3. Strip 1 1/4" of insulation from each of the 12" pieces leaving a 6" lead on each.	. SC-2-6
4. Twist 20 three wire taps with 6" leads.	. SC-2-8

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Light a Propane Torch
UNIT II: Wiring Methods
COURSE: Electrical Occupations
MATERIAL: Match
EQUIPMENT: Propane Torch
SAFETY PRECAUTIONS:

JOB SHEET
IDENTIFICATION CODE
JOB NUMBER: J-2-9

Caution: Torch head is hot! DO NOT TOUCH!

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Light and turn off the torch 10 times.	. SC-2-9

METHOD OF EVALUATION:

The instructor will make sure the "off-on" valve is not damaged after use.

JOB: Solder #14 Two Wire Taps

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: Solder - Rosin Core
25' 14 TW Solid Wire

EQUIPMENT: Propane Torch

TOOLS: Wire Strippers
7" Side Cutters
12' Steel Tape Rule

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-10

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut the wire into 40 7" pieces.	. SC-2-1
2. Strip about 1 1/4" of insulation from each end of each wire.	. SC-2-3
3. Twist a two wire tap of each end of each pair of wires.	. SC-2-4
4. Light the torch.	. SC-2-9
5. Solder the taps.	. SC-2-10

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Solder Two #14 Wires With a
Soldering Gun

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-11

COURSE: Electrical Occupations

MATERIAL: 14' #14 TW Solid Wire
Solder Rosin Core

TOOLS: Wire Strippers
7" Side Cutters
Soldering Gun
12' Steel Tape Rule

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut the wire into 24 7" pieces.	. SC-2-1
2. Strip about 1 1/4" of insulation from each end of each wire.	. SC-2-3
3. Twist a two wire tap on each end of each pair of wires.	. SC-2-4
4. Solder the taps with a soldering gun.	. SC-2-11

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Tape #12 Conductors
UNIT II: Wiring Methods
COURSE: Electrical Occupations
MATERIAL: 14' #12 TW Solid Wire
Plastic Tape
EQUIPMENT: Solder - Rosin Core
TOOLS: Wire Strippers
7" Side Cutters
Soldering Gun
12' Steel Tape Rule

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-12

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut the wire into 24 7" pieces.	. SC-2-1
2. Strip about 1 1/4" of insulation from each end of each wire.	. SC-2-3
3. Twist a two wire tap on each end of each pair of wires.	. SC-2-4
4. Solder the taps with a soldering gun.	. SC-2-11
5. Tape the conductors.	. SC-2-12

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Tape #14 Conductors With a Lead

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-13

COURSE: Electrical Occupations

MATERIAL: 48' #12 TW Solid Wire
Solder - Rosin Core
Tape

TOOLS: Wire Strippers
7" Side Cutters
Pocket Knife
Propane Torch
12' Steel Tape Rule

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut the wire into 24 12" pieces and 48 6" pieces.	. SC-2-1
2. Strip about 1 1/4" of insulation from one end of each 6" piece.	. SC-2-3
3. Strip about 1 1/4" of insulation from the 12" pieces leaving a 6" lead on each.	. SC-2-6
4. Twist a three wire tap with a 6" lead from each group of three wires.	. SC-2-8
5. Light the torch.	. SC-2-9
6. Solder the taps with the torch.	. SC-2-10
7. Tape the conductors.	. SC-2-13

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Mount Wall Cases

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-14

COURSE: Electrical Occupations

MATERIAL: 10 Deep Wall Cases with Side Mounting
20 Duplex Nails

TOOLS: Ripping Hammer
6' Wooden Rule

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Mount the wall cases on studded wall.	. SC-2-14

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Put Drill Bits in a Chuck
UNIT II: Wiring Methods
COURSE: Electrical Occupations
EQUIPMENT: 1/4" Drill Motor
TOOLS: 1 Set Flat Boring Wood Bits
SAFETY PRECAUTIONS:

JOB SHEET
IDENTIFICATION CODE
JOB NUMBER: J-2-15

When installing bits, make sure the drill is unplugged.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Put each drill bit in the chuck and then remove each.	. SC-2-15

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Drill 3/8" Holes in Wood Studs

UNIT II: Wiring Methods

COURSE: Electrical Occupation

MATERIAL: 19" of 2 X 4 lumber

EQUIPMENT: 1/4" Drill Motor

TOOLS: 3/8" Flat Boring Wood Bit
25' Extension Cord
2 6" C Clamps
12' Steel Tape

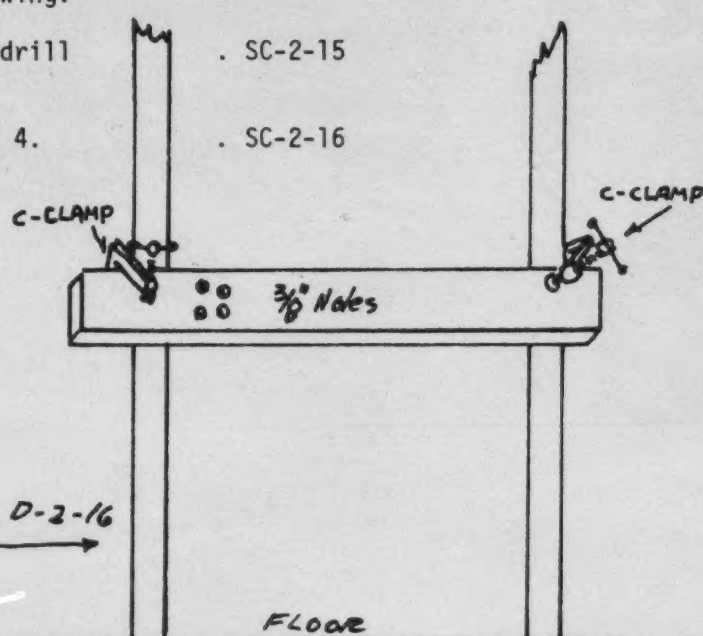
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-16

SAFETY PRECAUTIONS:

Keep both hands on the drill.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clamp the 2 X 4 as shown on drawing.	
2. Place the 3/8" wood bit in the drill motor.	. SC-2-15
3. Drill about 90 holes in the 2 X 4.	. SC-2-16



METHOD OF EVALUATION:

The instructor will check the finished work.

TOOLS: 7" Side Cutters

JOB NUMBER: J-2-17

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JOB: Staple 12-2 With Ground Romex

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-18

COURSE: Electrical Occupations

MATERIAL: 2' 2 X 4 Lumber
48 Romex Staples
2' 12-2 W/G Romex

TOOLS: Claw Hammer
7" Side Cutters

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the 2 X 4 on the work table.	
2. Staple the Romex on the 2 X 4 every 1/2".	. SC-2-18

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Remove Wall Case Knock Outs (K.O.'s)
UNIT II: Wiring Methods
COURSE: Electrical Occupations
MATERIAL: 4 Wall Cases
TOOLS: 8" Screwdriver

JOB SHEET
IDENTIFICATION CODE
JOB NUMBER: J-2-19

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the K.O.'s from the wall cases.	. SC-2-19

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Strip 12-2 With Ground Romex

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: 12' 12-2 W/G Romex

TOOLS: 7" Sidecutters
Romex strippers
Pocket Knife
12' Steel Tape

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-20

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut romex into 10 14" pieces.	. SC-2-1
2. Strip about 5" of covering from each end of each piece.	. SC-2-20

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Clamp 12-2 With Ground Romex to
Wall Cases
UNIT II: Wiring Methods
COURSE: Electrical Occupations
MATERIAL: 5 Wall Cases
10 8d Duplex Nails
10' 12-2 W/G Romex
TOOLS: Screwdriver
Romex Stripper
Pocket Knife
7" Side Cutters
Claw Hammer

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-21

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount the boxes on studded walls.	. SC-2-14
2. Cut the wire into 5 2' pieces.	. SC-2-1
3. Remove the K.O.'s from wall cases.	. SC-2-19
4. Strip about 8" of covering from each piece of Romex.	. SC-2-20
5. Clamp a cable to each wall case.	. SC-2-21

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Bend Hocks on #14 Solid Wire

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: 17' #14 Solid Wire

TOOLS: 7" Sidecutters
Wire Strippers
12' Steel Tape Rule

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-22

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut wire into 30 7" pieces.	. SC-2-1
2. Strip about 7/8" of insulation from each end of each wire.	. SC-2-3
3. Bend a hook on each end of each wire.	. SC-2-22

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Connect Solid Wire to Screws

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-23

COURSE: Electrical Occupations

MATERIAL: 12 Duplex Receptacles
18' #12 TW Solid Wire

TOOLS: 7" Side Cutters
Wire Strippers
12' Steel Tape Rule
6" Screwdriver

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut the wire into 6" pieces.	. SC-2-1
2. Strip about 7/8" of insulation from 1 end of each piece.	. SC-2-3
3. Bend a hook on the stripped end of each conductor.	. SC-2-22
4. Connect the conductors to the receptacles.	. SC-2-23

METHOD OF EVALUATION:

The instructor will check the finished work.

JOB: Install A Duplex Receptacle

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-24

COURSE: Electrical Occupations

DRAWING NO: D-2-24

MATERIAL: 3½" Deep Wall Case Duplex Outlet
(2) Romex Staples Duplex Cover
(4) 12-2 W/G Romex 10/32 Ground Screw (2) 8 Penny Nails

EQUIPMENT: ¼" Drill Motor
25' Extension Cord

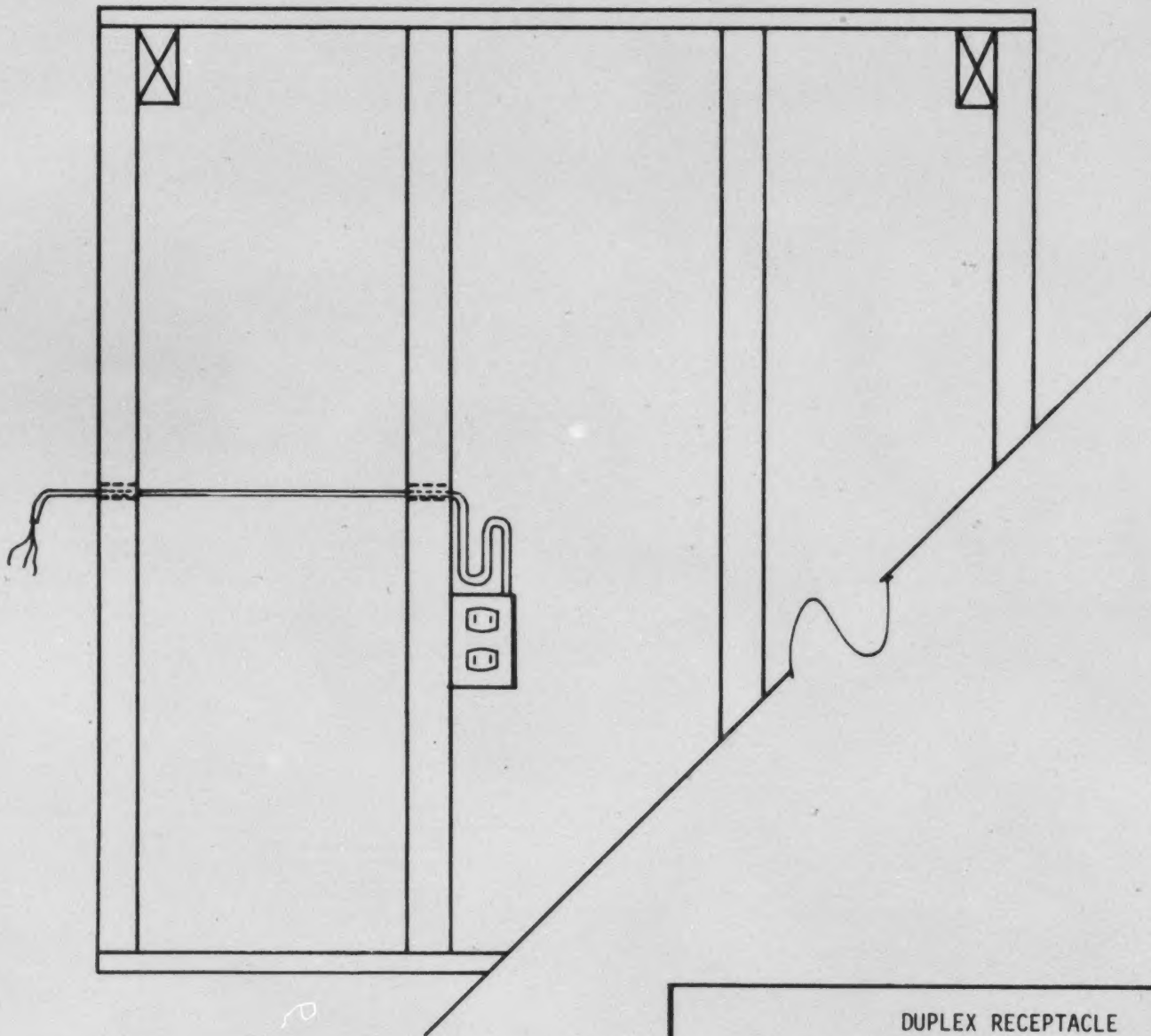
TOOLS: 7" Side Cutters Romex Strippers
Pocket Knife ½" Wood Bit-flat Boring 8" Screwdriver
Claw Hammer 6' Wooden Rule Wire Strippers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount the wall case for 3/8" sheet rock.	. SC-2-14, IL-2-2
2. Drill holes in studs.	. SC-2-16
3. Pull the wire in.	. SC-2-17
4. Strip the Romex about 8".	. SC-2-20
5. Remove K.O. from wall case.	. SC-2-19
6. Clamp the Romex to the wall case.	. SC-2-21
7. Staple the Romex.	. SC-2-18
8. Strip the ends of the conductor about 7/8".	. SC-2-3
9. Bend a hook on the conductors.	. SC-2-22
10. Attach bare wire to the box and the device.	. IL-2-3, IL-2-5
11. Attach the insulated conductors to the device.	. IL-2-23, IL-2-3

METHOD OF EVALUATION:

The instructor will check the finished work.

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DUPLEX RECEPTACLE

51

DRAWING NUMBER

D-2-24

JOB: Install 2 Duplex Receptacles

UNIT II: Wiring Methods

COURSE: Electrical Occupations

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-25

DRAWING NO: D-2-25

MATERIAL: Ground Splice Cap (8) 12-2 W/G Romex
(4) 8 Penny Nails (2) 10/32 Ground Screws
(2) Duplex Outlets (2) 3½" Deep Wall Cases Rosin Core
(2) Romex Staples (2) Duplex Plastic Covers Plastic Tape

EQUIPMENT: ¼" Drill Motor
25' Extension Cord
Propane Torch - Pencil Tip

TOOLS: 8" Screwdriver 7" Side Cutters Ground Splice Crimpers
Wire Strippers Claw Hammer 6' Wooden Rule
Pocket Knife Romex Strippers ½" Wood Bit - Flat Boring

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount the wall cases.	. SC-2-14, IL-2-2
2. Drill holes in studs.	. SC-2-16
3. Pull wire in.	. SC-2-17
4. Strip the Romex about 8".	. SC-2-20
5. Remove K.O. from box.	. SC-2-19
6. Clamp Romex to wall cases.	. SC-2-21
7. Staple Romex.	. SC-2-18
8. Make up taps leaving a 6" lead.	. SC-2-6, SC-2-7, IL-2-4
9. Light the torch.	. SC-2-9
10. Solder the taps.	. SC-2-10
11. Tape taps.	. SC-2-13
12. Install ground splice cap.	. SC-2-24, IL-2-5
13. Strip the ends of the conductors about 7/8".	. SC-2-3

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
14. Bend a hook on the conductors.	. SC-2-22
15. Attach ground wire to the box and devices.	. IL-2-3, IL-2-5
16. Attach insulated conductor to devices.	. SC-2-23, IL-2-3

METHOD OF EVALUATION:

The instructor will check the finished work.

79

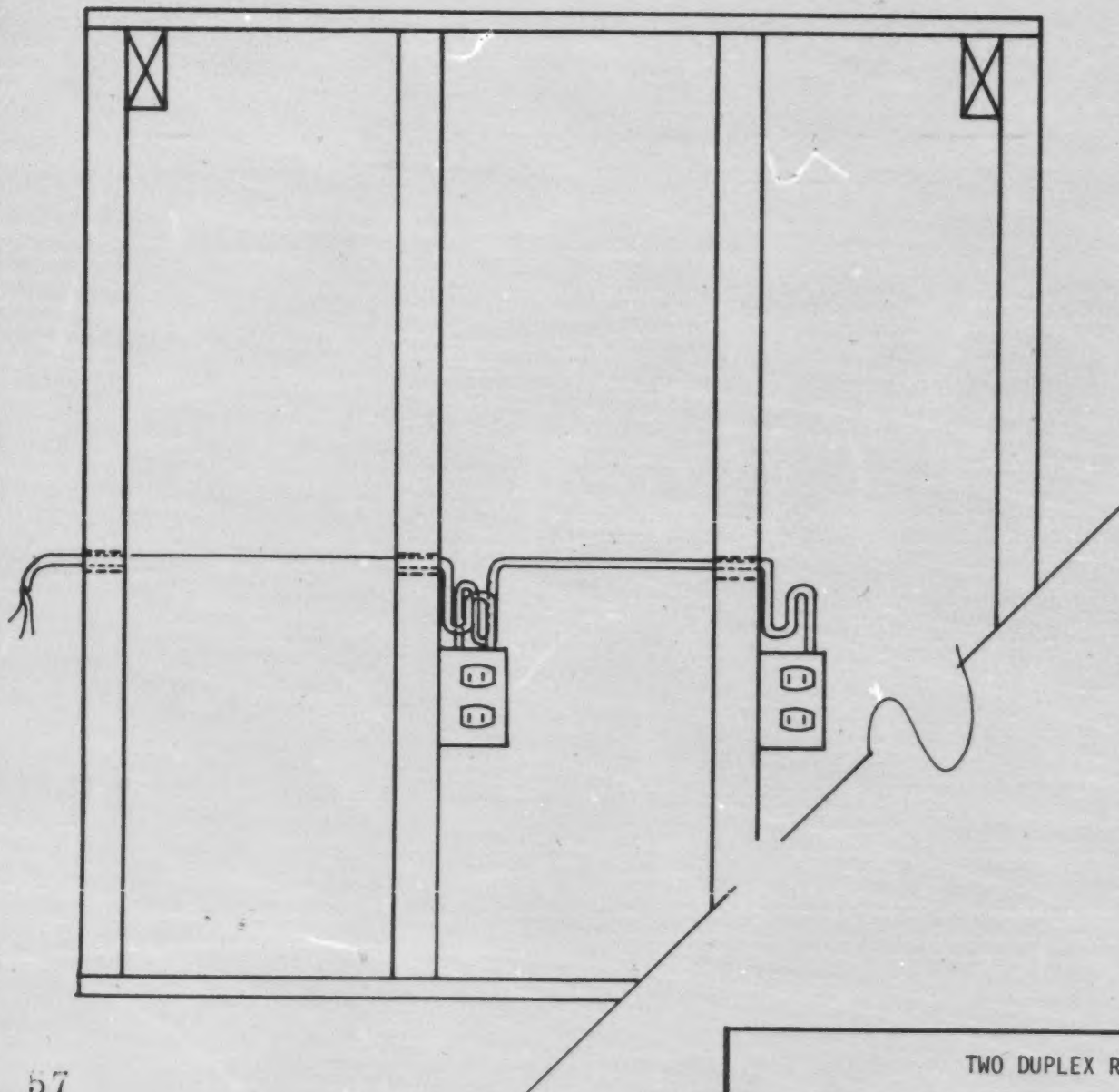
57

58

TWO DUPLEX RECEPTACLES

DRAWING NUMBER

D-2-25



JOB: Install 5 Duplex Receptacles

UNIT II: Wiring Methods

COURSE: Electrical Occupations

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-26

DRAWING NO: D-2-26

MATERIAL:	(5) Romex Staples	(12) 12-2 W/G Romex	
	(5) Duplex Outlets	(4) Ground Splice Caps	
	(5) Duplex Covers	(5) 3½" Deep Wall Cases	Rosin Core
	(10) 8 Penny Nails	(5) 10/32 Ground Screws	Plastic Tape

EQUIPMENT: ¼" Drill Motor
25' Extension Cord
Propane Torch - Pencil Tip

TOOLS:	8" Screwdriver	7" Side Cutters	Ground Splice Crimpers
	Wire Strippers	Claw Hammer	6' Wooden Rule
	Pocket Knife	Romex Strippers	½" Wood Bit - Flat Boring

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount wall cases.	. SC-2-14, IL-2-2
2. Drill holes in studs.	. SC-2-16
3. Pull wire in.	. SC-2-17
4. Strip about 8" Romex.	. SC-2-20
5. Remove K.O. from box.	. SC-2-19
6. Clamp Romex to wall cases.	. SC-2-21
7. Staple Romex.	. SC-2-18
8. Make up taps leaving a 6" lead.	. SC-2-6, SC-2-7, IL-2-4
9. Light the torch.	. SC-2-9
10. Solder the taps.	. SC-2-10
11. Tape the taps.	. SC-2-13
12. Install ground splice cap.	. SC-2-24
13. Strip the ends of the conductors about 7/8".	. SC-2-3
14. Bend a hook on the conductors.	. SC-2-22

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
15. Attach ground wire to the box and devices.	. IL-2-3
16. Attach insulated conductors to devices.	. IL-2-3

METHOD OF EVALUATION:

The instructor will check the finished work.

83

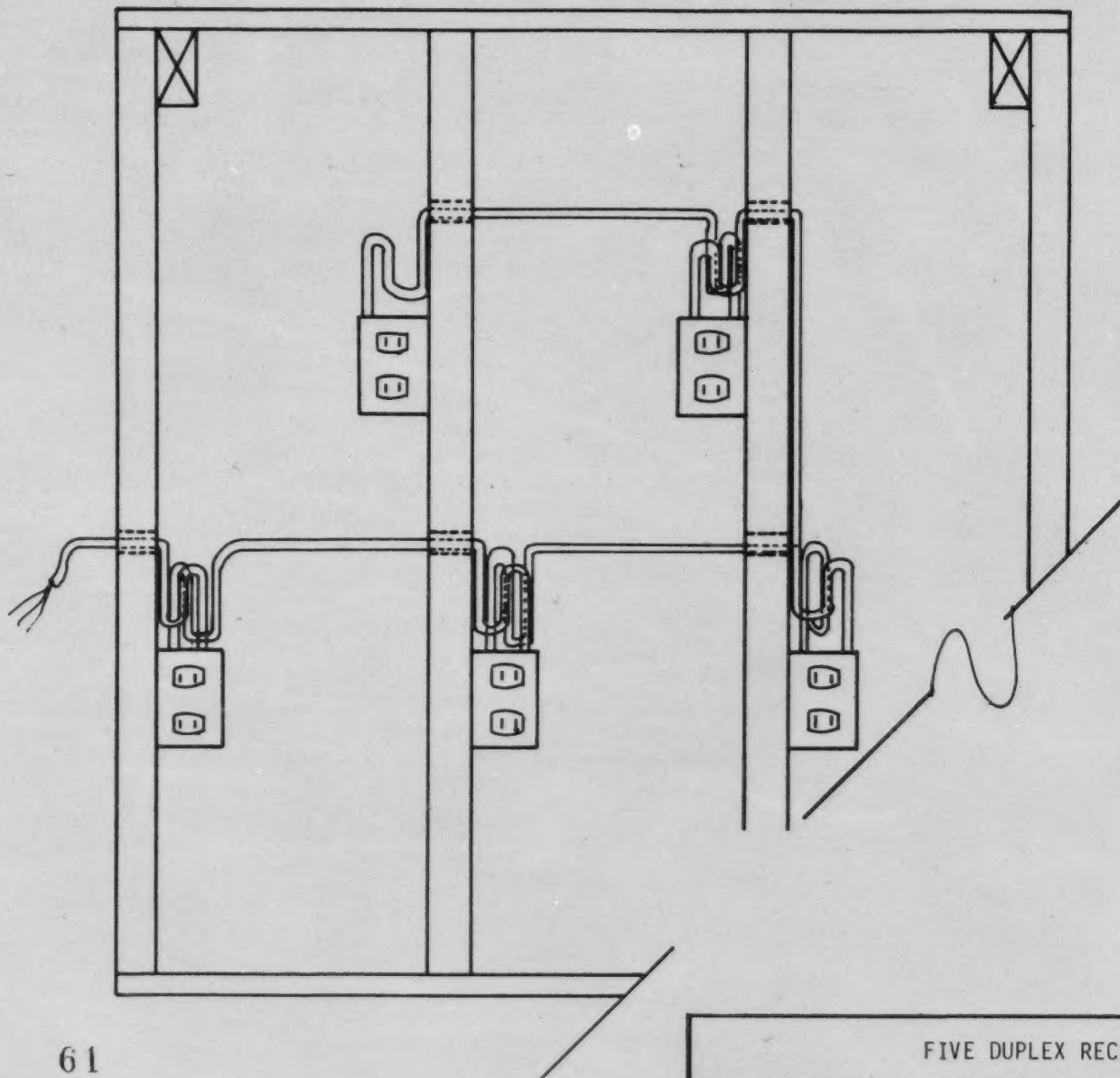
61

FIVE DUPLEX RECEPTACLES

62

DRAWING NUMBER

D-2-26



JOB: Install A Porcelain Light with
Pull String

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-27

COURSE: Electrical Occupations

DRAWING NO: D-2-27

MATERIAL: 4" Round Box (3) 12-2 W/G Romex 10/32 Ground Screw
(2) Staples 4" Porcelain Pull Fixture 100 Watt Light Bulb
Light Bar Hanger (2) 8 Penny Duplex Nails

EQUIPMENT: 1/4" Drill Motor 25' Extension Cord
1/2" Wood Bit 5' Step Ladder

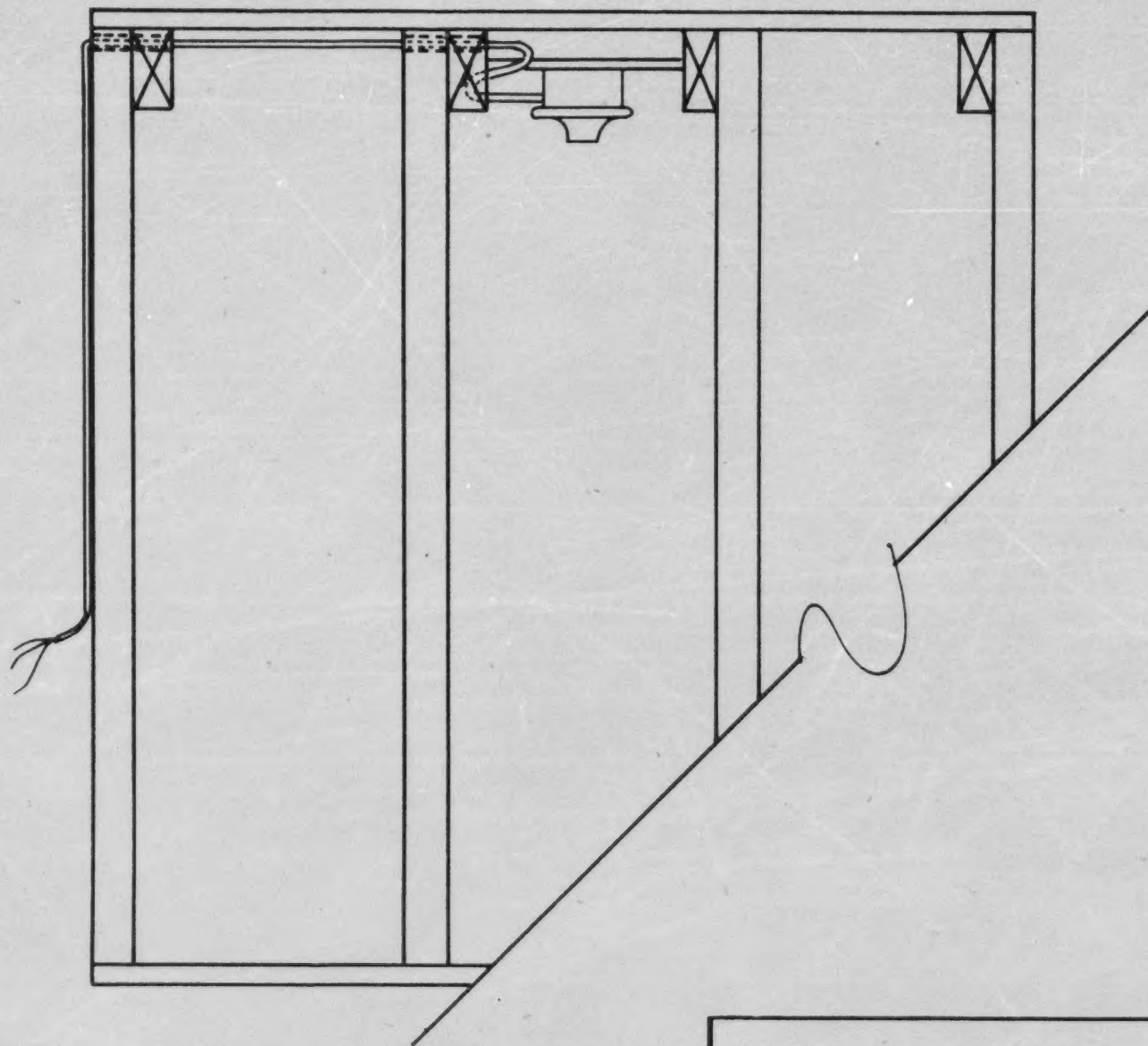
TOOLS: 7" Side Cutters Claw Hammer
Pocket Knife 8" Screwdriver
Romex Strippers Wire Strippers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install light bar hanger.	. SC-2-25, IL-2-2
2. Drill holes.	. SC-2-16
3. Pull the wire in.	. SC-2-17
4. Strip the Romex about 8".	. SC-2-20
5. Remove K.O. from box.	. SC-2-19
6. Clamp Romex to the box.	. SC-2-21
7. Staple the Romex.	. SC-2-18
8. Attach ground wire to the box.	. IL-2-5
9. Attach insulated conductors to devices.	. SC-2-23, IL-2-6

METHOD OF EVALUATION:

The instructor will check the finished work.

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65

PORCELAIN LIGHT WITH PULL STRING

DRAWING NUMBER

D-2-27

JOB: Install A Single Pole Switch
Controlling One Light with Feed
To A Switch Box

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-28

UNIT II: Wiring Methods

DRAWING NO: D-2-28

COURSE: Electrical Occupations

MATERIAL:	(7) Staples	Light Bar Hanger	
	Plastic Tape	Ground Splice Cap	3½" Deep Wall Cases
	4" Round Box	Rosin Core Solder	100 Watt Light Bulb
	(4) Penny Nails	Switch Plate Cover	(2) 10/32 Ground Screws
	12-2 W/G Romex	Single Pole Switch	4" Porcelain Pull Fixture

EQUIPMENT:	¼" Drill Motor	Propane Torch - Pencil Tip
	25' Extension Cord	½" Wood Bit - Flat Boring

TOOLS:	Claw Hammer	7" Side Cutters	
	Pocket Knife	8" Screwdriver	Romex Strippers
	6' Wooden Rule	Wire Strippers	Ground Splice Crimpers

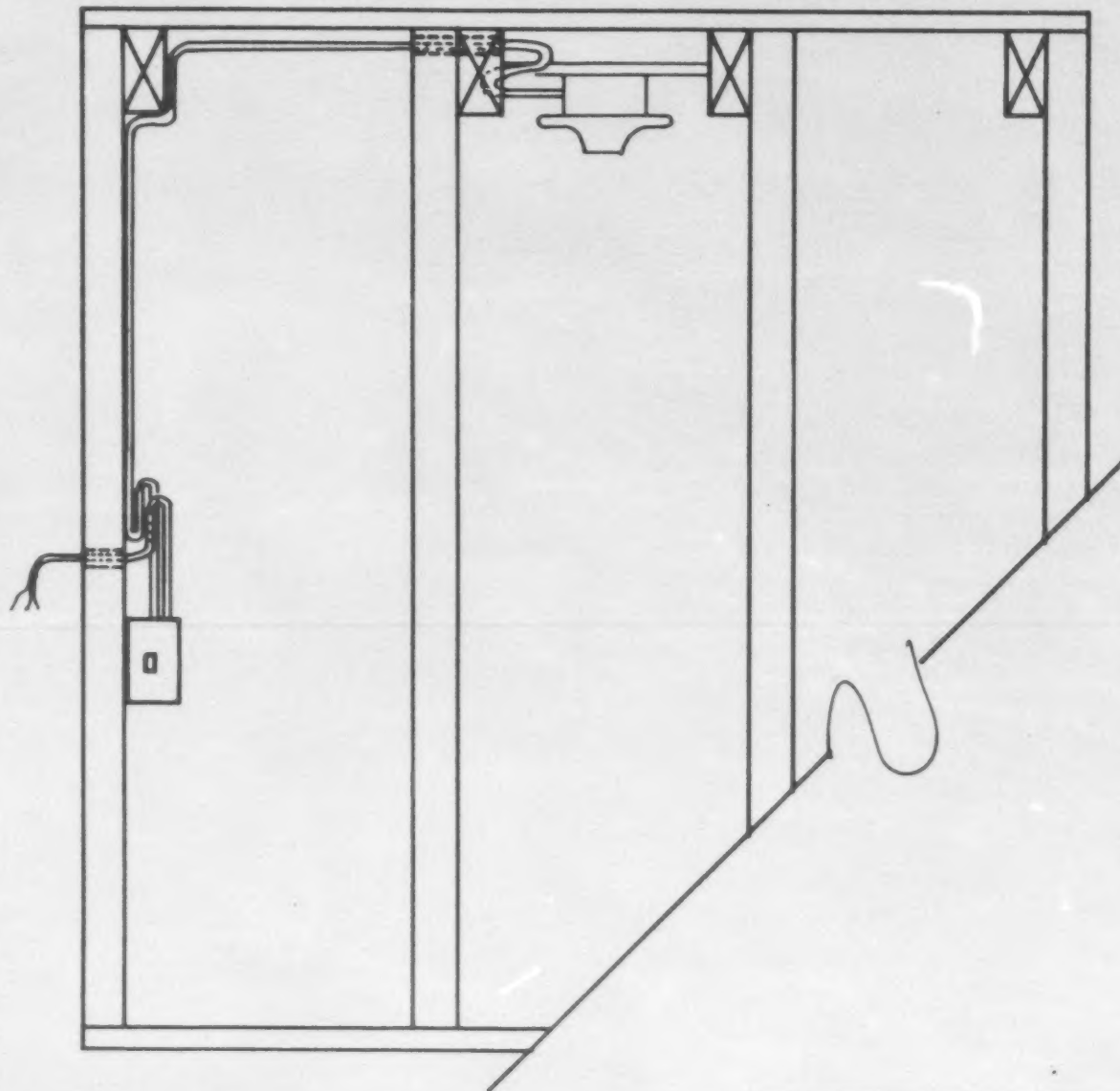
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install light bar hanger.	. SC-2-25, IL-2-2
2. Install wall case.	. SC-2-14, IL-2-8
3. Drill holes.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove K.O. from box.	. SC-2-19
8. Clamp the Romex to boxes.	. SC-2-21
9. Install ground splice cap.	. SC-2-24, IL-2-8
10. Twist tap (2 wire).	. SC-2-4, IL-2-8
11. Light torch.	. SC-2-9
12. Solder the tap.	. SC-2-10
13. Tape the tap.	. SC-2-12
14. Strip the ends of the conductors about 7/8".	. SC-2-3

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
15. Bend a hook eye on wire.	. SC-2-22
16. Attach all wires.	. SC-2-23, IL-2-8

METHOD OF EVALUATION:

The instructor will check the finished work.

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SINGLE POLE SWITCH WITH LIGHT WITH FEED TO A SWITCH BOX

68

DRAWING NUMBER

D-2-28

JOB: Install A Single Pole Switch
Controlling Two Lights with Feed
To A Switch Box

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-29

COURSE: Electrical Occupations

DRAWING NO: D-2-29

MATERIAL: (2) 4" Round Boxes (2) Light Bar Hangers
12/2 W/G Romex 3½" Deep Wall Case (3) 10/32 Ground Screws
Rosin Core Solder Single Pole Switch (6) 8 Penny Duplex Nails
(8) Staples Switch Plate Cover (2) Ground Splice Caps
Plastic Tape (2) 100 Watt Bulbs (2) 4" Porcelain Pl.lights

EQUIPMENT: ¾" Drill Motor 25' Extension Cord
½" Wood Bit - Flat Boring Propane Torch

TOOLS: Claw Hammer 7" Side Cutters
Pocket Knife 8" Screwdriver Wire Strippers
6' Wooden Rule Romex Strippers Ground Splice Crimpers

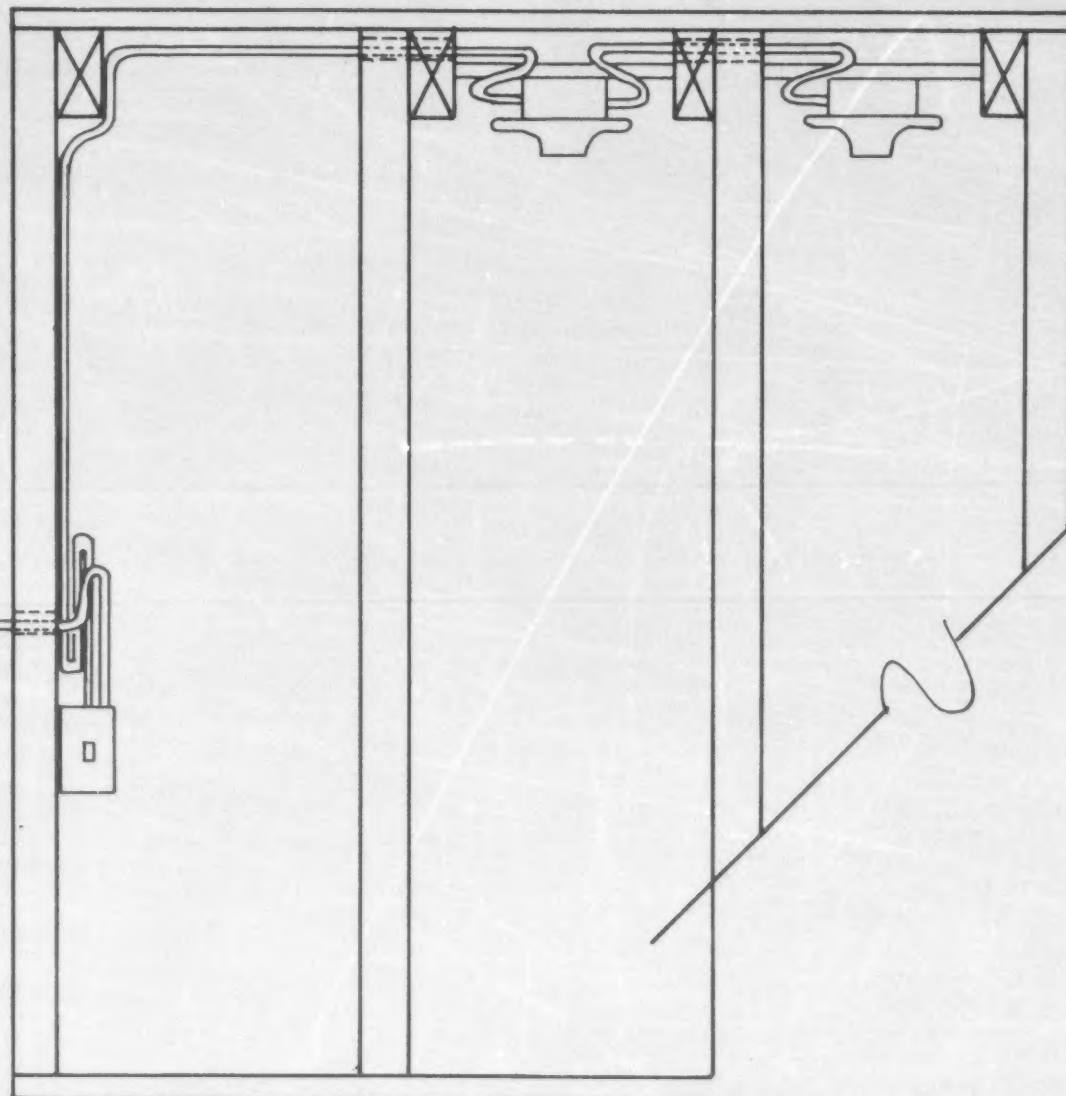
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install light bar hangers.	. SC-2-25
2. Install the wall case for the switch.	. SC-2-14, IL-2-14
3. Drill holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove K.O. from box.	. SC-2-19
8. Clamp the Romex to the box.	. SC-2-21
9. Install ground splice caps.	. SC-2-24
10. Twist taps.	. SC-2-4, IL-2-14
11. Light the torch.	. SC-2-9
12. Solder the taps.	. SC-2-10
13. Tape the taps.	. SC-2-12
14. Strip the end of the conductors about 7/8".	. SC-2-3

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
15. Bend hooks on wires.	. SC-2-22
16. Attach all wires to devices.	. SC-2-23, IL-2-14

METHOD OF EVALUATION:

The instructor will check the finished work.

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72

SINGLE POLE SWITCH CONTROLLING TWO LIGHTS WITH FEED TO SWITCH BOX

DRAWING NUMBER

D-2-29

JOB: Install A Single Pole Switch
Controlling One Light with A
Feed To The Light Box

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-30

COURSE: Electrical Occupations

DRAWING NO: D-2-30

MATERIAL: 4" Round Box 3½" Deep Wall Case
12/2 W/G Romex Rosin Core Solder Ground Splice Cap
(7) Staples Light Bar Hanger (2) 10/32 Ground Screws
(4) 8 Penny Nails 4" Porcelain Plain 100 Watt Light Bulb
Plastic Tape Light Fixture Single Pole Switch

EQUIPMENT: 25' Extension Cord Propane Torch
½" Wood Bit - Flat Boring ½" Drill Motor

TOOLS: Claw Hammer 8" Screwdriver
Pocket Knife 7" Side Cutters Wire Strippers
6' Wooden Rule Romex Strippers Ground Splice Crimpers

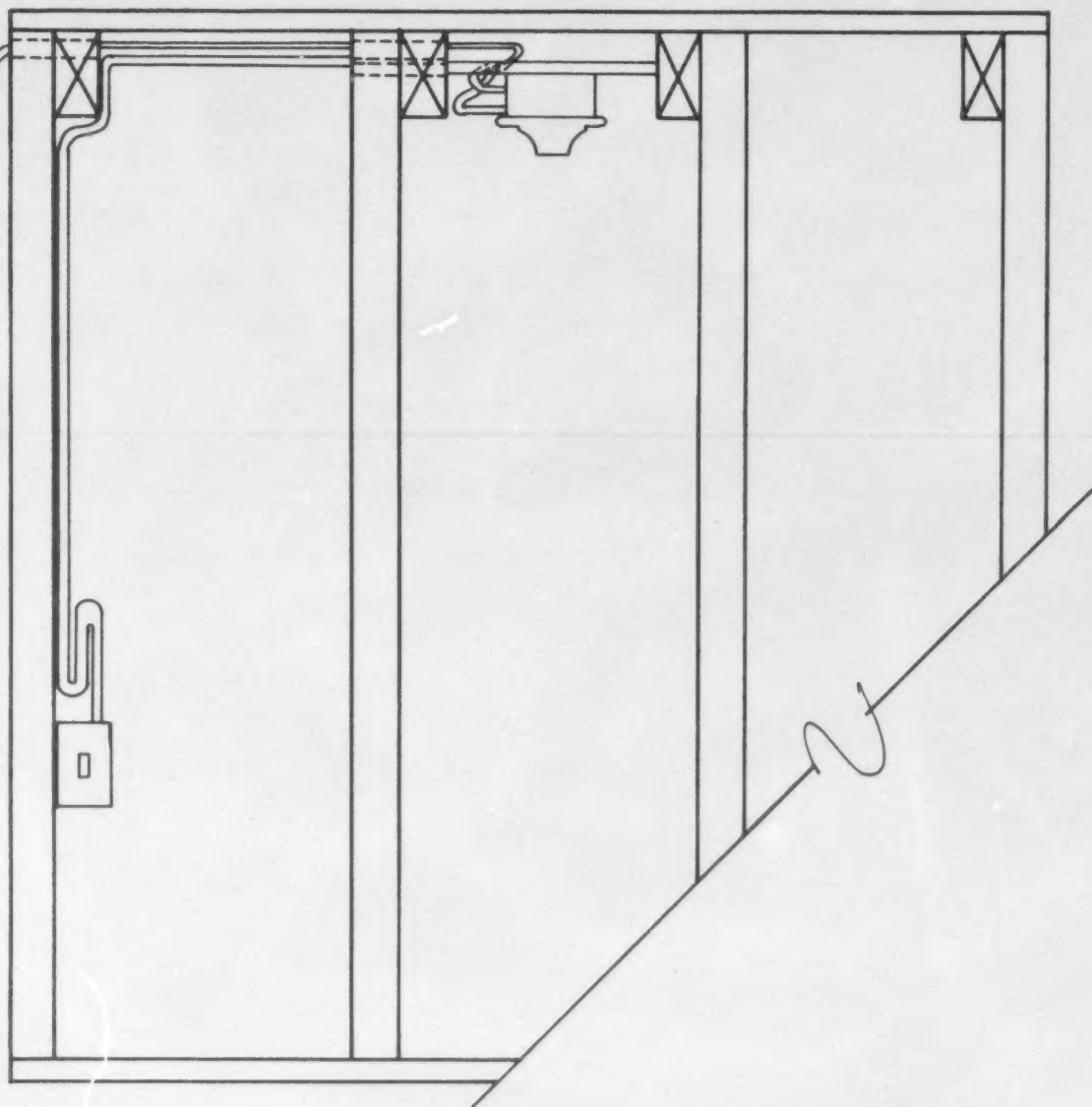
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install the light bar hanger.	. SC-2-25
2. Install the wall case for the switch.	. SC-2-14, IL-2-9
3. Drill holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove the K.O. from the box.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice cap.	. SC-2-24
10. Twist the taps.	. SC-2-4, IL-2-9
11. Light the torch.	. SC-2-9
12. Solder the taps.	. SC-2-10
13. Tape the taps.	. SC-2-12
14. Strip the ends of the conductors about 7/8".	. SC-2-3

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
15. Bend hooks on the wires.	. SC-2-22
16. Attach all wires.	. SC-2-23, IL-2-9

METHOD OF EVALUATION:

The instructor will check finished work.

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77

SINGLE POLE SWITCH CONTROLLING ONE LIGHT WITH FEED TO LIGHT BOX

DRAWING NUMBER

D-2-30

JOB: Install A Single Pole Switch
Controlling Two Lights with A
Feed To The Light Box

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-31

UNIT II: Wiring Methods

DRAWING NO: D-2-31

COURSE: Electrical Occupations

MATERIAL:	(2) 4" Round Boxes	(10) Romex Staples	(4) 8 Penny Duplex Nails
	12-2 W/G Romex	Single Pole Switch	(2) Light Bar Hangers
	Plastic Tape	Switch Plate Cover	(3) 10/32 Ground Screws
	(2) 4" Porcelain	Ground Splice Cap	(2) 100 Watt Light Bulbs
	Light Fixtures	3½" Deep Wall Case	Rosin Core Solder

EQUIPMENT:	¾" Drill Motor	½" Wood Bit - Flat Boring
	25' Extension Cord	Propane Torch - Pencil Tip

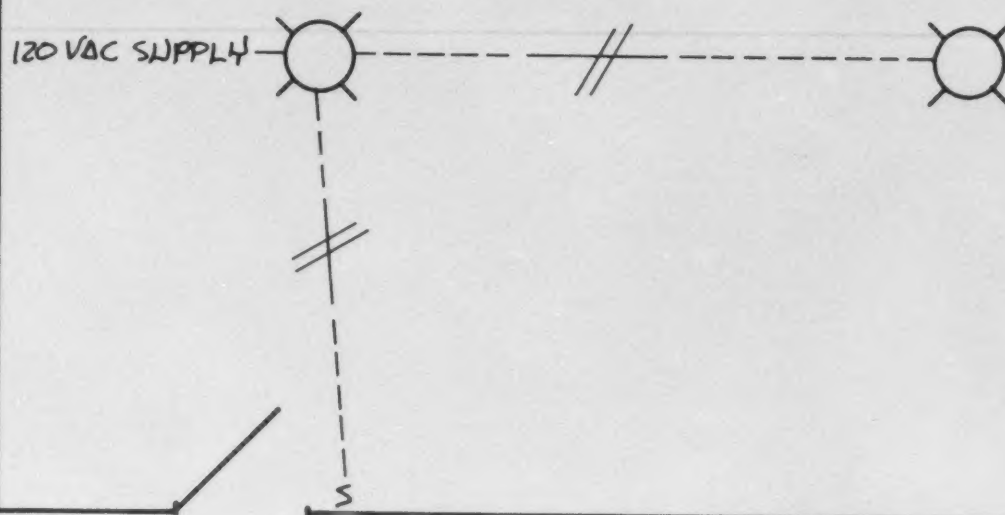
TOOLS:	Claw Hammer	8" Screwdriver	
	Pocket Knife	7" Side Cutters	Wire Strippers
	6' Wooden Rule	Romex Stripper	Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install light bar hangers.	. SC-2-25
2. Install the wall case for the switch.	. SC-2-14, IL-2-15
3. Drill holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove the K.O. from the box.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice cap.	. SC-2-24
10. Twist the taps.	. SC-2-4, IL-2-15
11. Light the torch.	. SC-2-9
12. Solder the taps.	. SC-2-10
13. Tape the taps.	. SC-2-12
14. Strip the ends of the conductors about 7/8".	. SC-2-3

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
15. Bend hooks on the wires.	. SC-2-22
16. Attach all wires.	. SC-2-23, IL-2-15

METHOD OF EVALUATION:

The instructor will check the finished work.



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SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
SINGLE POLE SWITCH CONTROLLING TWO LIGHTS WITH FEED TO LIGHT BOX		
		DRAWING NUMBER
		D-2-31 81

JOB: Install A Single Pole Switch
Controlling Three Lights with A
Feed To The End Light Box

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-32

UNIT II: Wiring Methods

DRAWING NO: J-2-32

COURSE: Electrical Occupations

MATERIAL:	Plastic Tape	Rosin Core Solder	(2) Ground Splice Caps
	(3) 4" Porcelain	(13) Romex Staples	(3) Light Bar Hangers
	Light Fixtures	Switch Plate Cover	(4) 10/32 Ground Screws
	(3) 4" Round Boxes	Single Pole Switch	(3) 100 Watt Light Bulbs
	17' 12-2 W/G Romex	3½" Deep Wall Case	(8) 6 Penny Duplex Nails

EQUIPMENT:	½" Drill Motor	½" Wood Bit - Flat Boring
	25' Extension Cord	Propane Torch - Pencil Tip

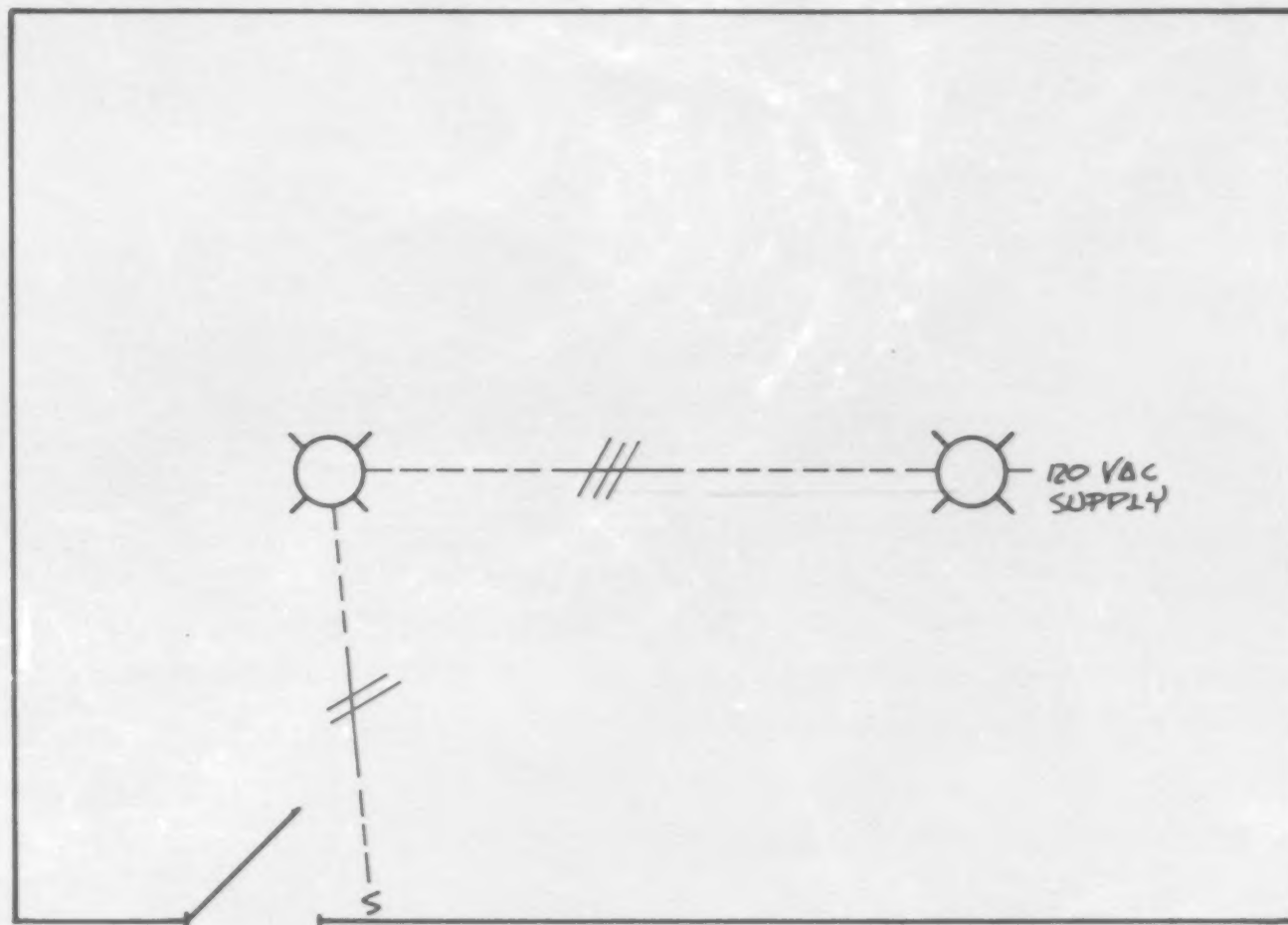
TOOLS:	Claw Hammer	Romex Strippers	Wire Strippers
	Pocket Knife	7" Side Cutters	Ground Splice Crimper
	6' Wooden Rule	8" Screwdriver	

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sketch a hook up of the job on the back of the job sheet.	. IL-2-15
2. Install the light bar hangers.	. SC-2-25
3. Install the wall case for the switch.	. SC-2-14, IL-2-15
4. Place the bit in the chuck and drill the holes in the studs.	. SC-2-16
5. Pull the wire in.	. SC-2-17, IL-2-15
6. Strip the Romex about 8".	. SC-2-20
7. Staple the Romex.	. SC-2-18
8. Remove the K.O. from the box.	. SC-2-19
9. Clamp the Romex to the boxes.	. SC-2-21
10. Install the ground splice caps.	. SC-2-24
11. Twist the taps.	. SC-2-4, IL-2-15
12. Light the torch.	. SC-2-9
13. Solder the taps.	. SC-2-10

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
14. Tape the taps.	. SC-2-12
15. Strip the end of the conductors about 7/8".	. SC-2-3
16. Bend a hook on the wires.	. SC-2-22
17. Attach all the wires.	. SC-2-23, IL-2-15

METHOD OF EVALUATION:

The instructor will check sketch and quality of job.



SCALE:		APPROVED BY:		DRAWN BY:	
DATE:				REVISED:	
SINGLE POLE SWITCH CONTROLLING THREE LIGHTS WITH FEED TO THE END LIGHT BOX					85
DRAWING NUMBER					D-2-32

JOB: Install A Single Pole Switch with Pilot Light Controlling One Light with A Feed To The Switch Box

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-33

UNIT II: Wiring Methods

DRAWING NO: D-2-33

COURSE: Electrical Occupations

MATERIAL:	(7) Staples	(4) 8 Penny Nails	
	Plastic Tape	Ground Splice Cap	3½" Deep Wall Cases
	4" Round Box	Rosin Core Solder	100 Watt Light Bulb
	12-2 W/G Romex	Switch Plate Cover	(2) 10/32 Ground Screws
	Light Bar Hanger	Single Pole Switch	4" Procelain Plain Light Fix

EQUIPMENT:	¼" Drill Motor	½" Wood Bit - Flat Boring
	25' Extension Cord	Propane Torch - Pencil Tip

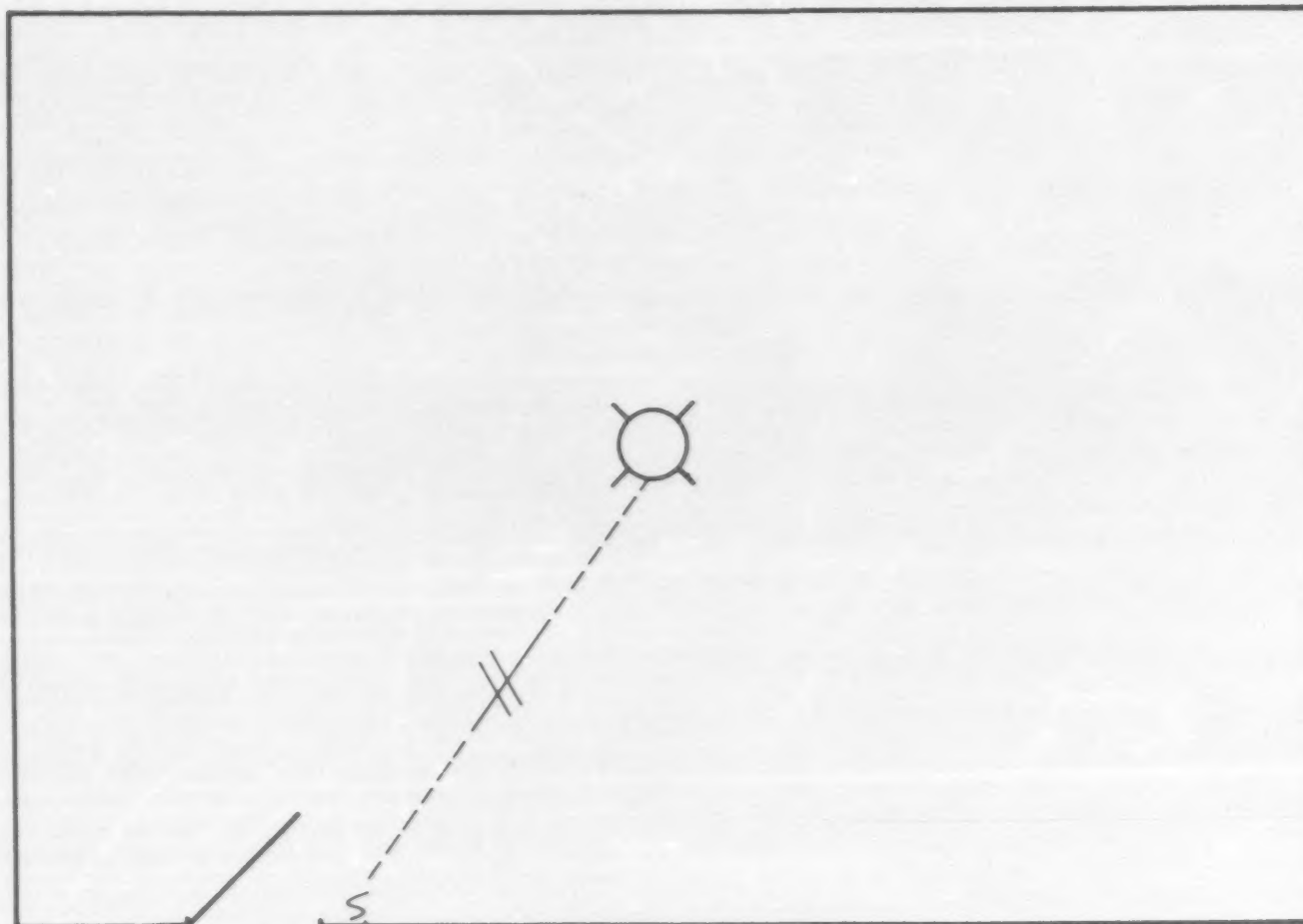
TOOLS:	Claw Hammer	Romex Stripper	Wire Strippers
	Pocket Knife	8" Screwdriver	Ground Splice Crimpers
	6' Wooden Rule	7" Side Cutters	

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install the light box hanger.	. SC-2-25
2. Install the wall case for the switch.	. SC-2-14, IL-2-8
3. Drill holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8"	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove K.O. from box.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice cap.	. SC-2-24
10. Twist taps.	. SC-2-4, IL-2-8
11. Light the torch.	. SC-2-9
12. Solder the taps.	. SC-2-10
13. Tape the taps.	. SC-2-12
14. Strip the end of the conductors about 7/8".	. SC-2-3

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
15. Bend hooks on the wires.	. SC-2-22
16. Attach all wires.	. SC-2-23, IL-2-8

METHOD OF EVALUATION:

The instructor will check the finished work.



120 VAC SUPPLY

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SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
SINGLE POLE SWITCH WITH PILOT LIGHT CONTROLLING ONE LIGHT WITH FEED TO THE SWITCH BOX		
		DRAWING NUMBER
		D-2-33 89

JOB: Install Two Lights on The Same
Circuit--Each Light Controlled by
Its Own Single Pole Switch

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-34

COURSE: Electrical Occupations

DRAWING NO: D-2-34

MATERIAL: (4) 10/32 Ground Screws (2) Ground Splice Caps
(2) 3½" Deep Wall Cases Plastic Tape Rosin Core Solder
(2) Switch Plate Covers 12-2 W/G Romex (2) Light Bar Hangers
(2) Single Pole Switches (2) 4" Round Box (2) Porcelain Plain
(4) 100 Watt Light Bulbs (8) Romex Staples Fixtures

EQUIPMENT: ¼" Drill Motor
25' Extension Cord ½" Wood Bit - Flat Boring
6' Step Ladder Propane Torch - Pencil Tip

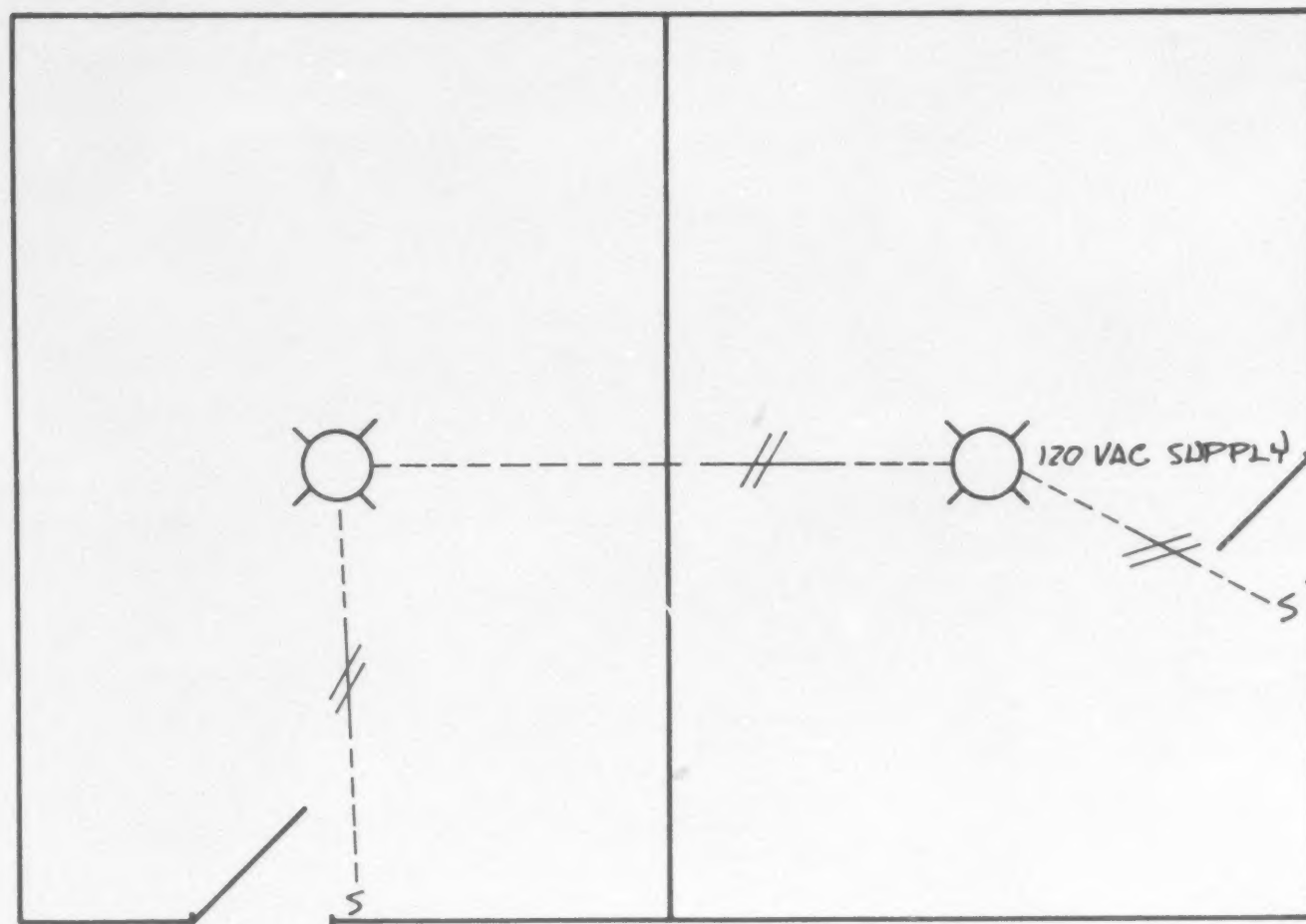
TOOLS: Claw Hammer Romex Stripper
Pocket Knife 8" Screwdriver Wire Strippers
6' Wooden Rule 7" Side Cutters Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install the light bar hangers.	. SC-2-25
2. Install the wall case for the switch.	. SC-2-14, IL-2-16
3. Drill holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17, IL-2-16
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove the K.O. from the box.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice caps.	. SC-2-24
10. Twist the taps.	. SC-2-4, IL-2-16
11. Light the torch.	. SC-2-9
12. Solder the taps.	. SC-2-10
13. Tape the taps.	. SC-2-12

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
14. Strip the end of the conductors about 7/8".	. SC-2-3
15. Bend hooks on the wires.	. SC-2-22
16. Attach all wires.	. SC-2-3

METHOD OF EVALUATION:

The instructor will check the finished work.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
TWO LIGHTS ON THE SAME CIRCUIT-- EACH LIGHT CONTROLLED BY ITS OWN SINGLE POLE SWITCH		
		DRAWING NUMBER D-2-34 93

JOB: Install Two Lights Controlled by
A Dimmer Switch With Feed To The
Light

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-35

COURSE: Electrical Occupations

DRAWING NO: D-2-35

MATERIAL: Plastic Tape 20' 12-2 W/G Romex
Dimmer Switch (2) Light Bar Hangers (2) Porcelain
Rosin Core Solder (2) Ground Splice Caps Plain Fixtures
(8) Romex Staples (3) 10/32 Ground Screws Switch Plate Cover
(2) 4" Round Boxes (2) 100 Watt Light Bulbs 3½" Deep Wall Cases

EQUIPMENT: ¼" Drill Motor ½" Wood Bit - Flat Boring
25' Extension Cord Propane Torch - Pencil tip

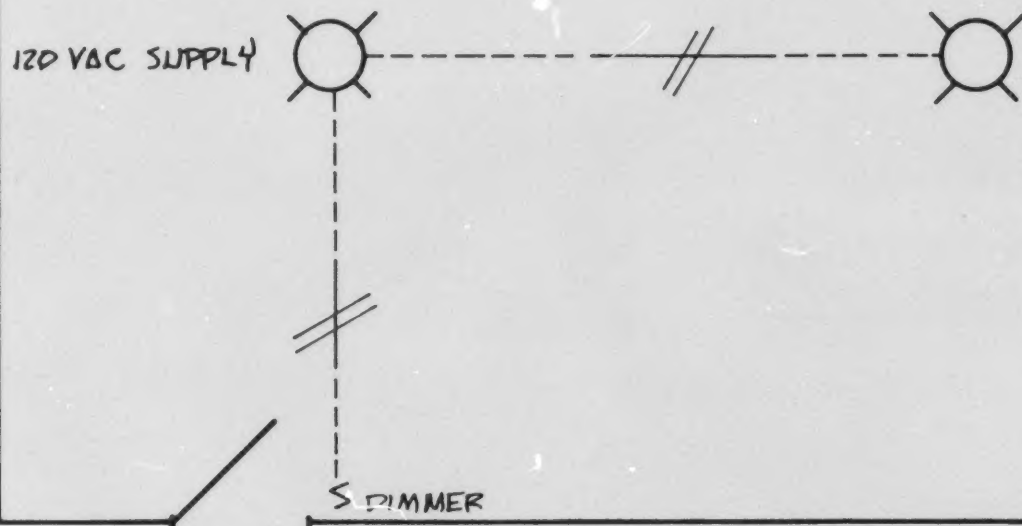
TOOLS: Claw Hammer 7" Side Cutters Romex Stripper
Pocket Knife 8" Screwdriver Wire Strippers
6' Wooden Rule 6' Step Ladder Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sketch a hook up of the job on the back of the job sheet.	. IL-2-9
2. Install the light bar hangers.	. SC-2-25
3. Install the wall case for the switch.	. SC-2-14, IL-2-9
4. Place the bit in the chuck and drill the holes in the studs.	. SC-2-16
5. Pull the wire in.	. SC-2-17
6. Strip the Romex about 8".	. SC-2-20
7. Staple the Romex.	. SC-2-18
8. Remove the K.O. from the box.	. SC-2-19
9. Clamp the Romex to the boxes.	. SC-2-21
10. Install the ground splice caps.	. SC-2-24
11. Twist the taps.	. SC-2-4, IL-2-16
12. Light the torch.	. SC-2-9
13. Solder the taps.	. SC-2-10

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
14. Tape the taps.	. SC-2-12
15. Strip the end of the conductors about 7/8".	. SC-2-3
16. Bend hooks on the wires.	. SC-2-22
17. Attach all wires.	. SC-2-23, IL-2-16

METHOD OF EVALUATION:

The instructor will check the sketch and quality of the finished job.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
TWO LIGHTS CONTROLLED BY DIMMER SWITCH WITH FEED TO THE LIGHT		
		DRAWING NUMBER
		D-2-35 97

JOB: Install Five Receptacles on The
Same Circuit and Switch One
Receptacle

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-36

COURSE: Electrical Occupations

DRAWING NO: D-2-36

MATERIAL: Plastic Tape (5) Duplex Receptacle Covers
(16) Romex Staples (5) Ground Splice Caps
6' 12-3 W/G Romex (5) Duplex Receptacles
48' 12-2 W/G Romex (6) 3½" Deep Wall Cases
Rosin Core Solder (6) 10/32 Ground Screws
Single Pole Switch (12) 8 Penny Duplex Nails
Switch Plate Cover Wire Nut for Two #12 Wires

EQUIPMENT: ¼" Drill Motor ½" Wood Bit - Flat Boring
25' Extension Cord Propane Torch - Pencil Tip

TOOLS: Claw Hammer 8" Screwdriver
Pocket Knife Romex Stripper Wire Strippers
6' Wooden Rule 7" Side Cutters Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sketch a hook up of the job on the back of the job sheet.	. IL-2-17
2. Install the wall cases.	. SC-2-14
3. Place the bit in the chuck and drill the holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove the K.O.'s from the boxes.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice caps.	. SC-2-24
10. Strip the wires.	. SC-2-3
11. Twist the taps.	. SC-2-7, IL-2-17
12. Light the torch.	. SC-2-9

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
13. Solder the taps.	. SC-2-10
14. Tape the taps.	. SC-2-12
15. Strip the ends of the conductors about 7/8".	. SC-2-3
16. Bend hooks on the wires.	. SC-2-22
17. Attach all wires.	. SC-2-23, 1L-2-17

METHOD OF EVALUATION:

The instructor will check the sketch and quality of the finished job.

JOB: Install Three Receptacles and
Switch The Top Half of The First
Receptacle

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-37

COURSE: Electrical Occupations

DRAWING NO: D-2-37

MATERIAL: Plastic Tape
(10) Staples
Rosin Core Solder
Single Pole Switch
Switch Plate Cover
16' 12-3 W/G Romex
28' 12-2 W/G Romex

(3) Ground Splice Caps
(3) Duplex Receptacles
(4) 3½" Deep Wall Cases
(4) 10/32 Ground Screws
(8) 8 Penny Duplex Nails
Wire Nut for Two #12 Wires
(3) Duplex Receptacle Covers

EQUIPMENT: ¼" Drill Motor
25' Extension Cord

½" Wood Bit - Flat Boring
Propane Torch - Pencil Tip

TOOLS: Claw Hammer
Pocket Knife
6' Wooden Rule
Romex Stripper

7" Side Cutters
8" Screwdriver
Wire Strippers
Ground Splice Crimpers

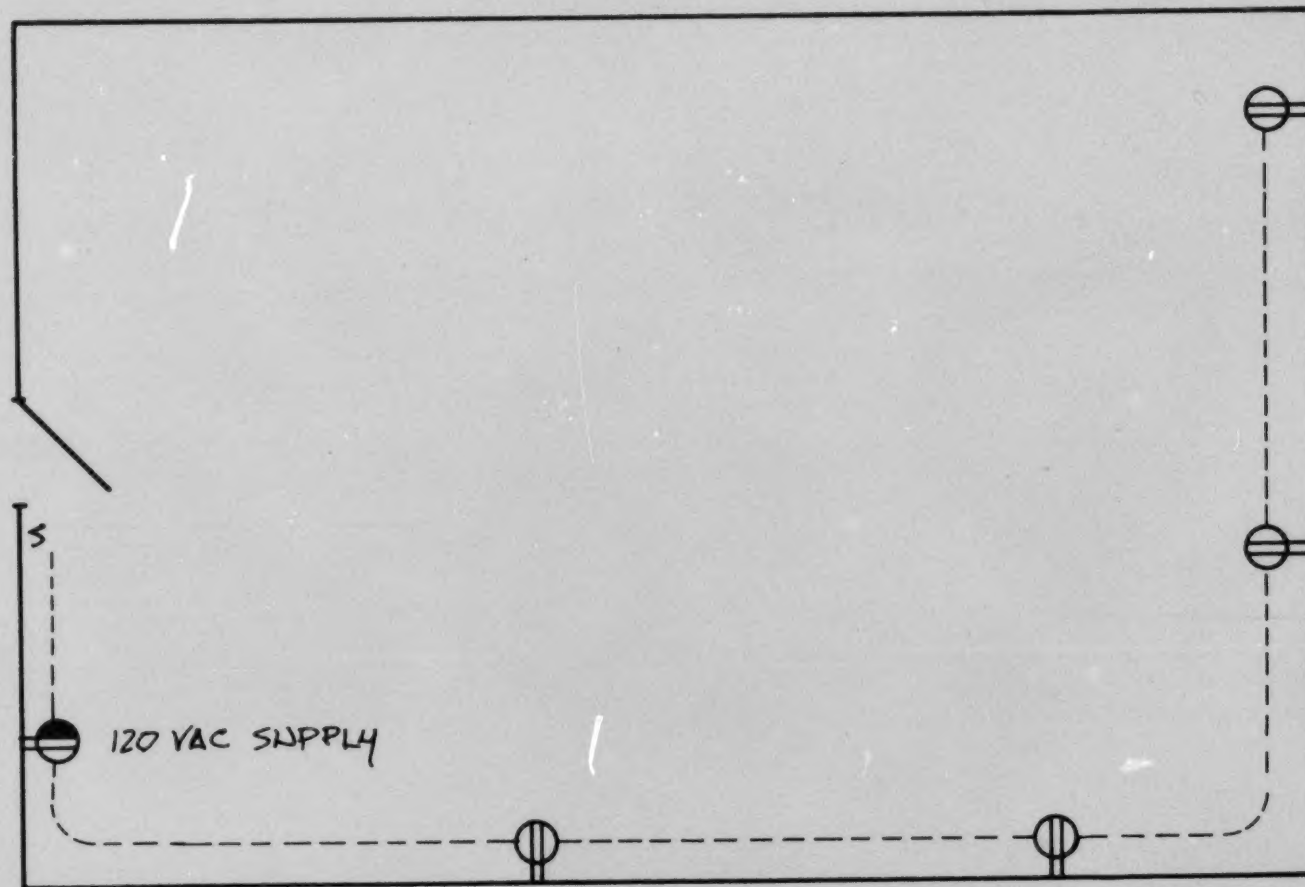
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sketch a hook up of the job on the back of the job sheet.	. IL-2-4, IL-2-17A
2. Install the wall cases.	. SC-2-14
3. Place the bit in the chuck and drill the holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex	. SC-2-18
7. Remove the K.O.'s from the boxes.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice caps.	. SC-2-24
10. Strip the wires.	. SC-2-3
11. Twist the taps.	. SC-2-7, IL-2-17A

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
12. Light the torch.	. SC-2-9
13. Solder the taps.	. SC-2-12
14. Tape the taps.	
15. Strip the end of the conductors about 7/8".	
16. Bend hooks on the wires.	. SC-2-22
17. Attach all wires.	. SC-2-23, IL-2-17A

METHOD OF EVALUATION:

The instructor will check the sketch and quality of the finished job.

127



102

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
THREE RECEPTACLES		
		DRAWING NUMBER D-2-37103

JOB: Install One Light Controlled by
Two Three-way Switches with Feed
To The Switch

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-38

COURSE: Electrical Occupations

DRAWING NO: D-2-38

MATERIAL: Plastic Tape
(5) Romex Staples
Light Bar Hanger
4" Round Box
14' 12-3 W/G Romex
2' 12-2 W/G Romex
(6) 8 Penny Nails
(2) Switch Covers

(2) 3-Way Switches
Rosin Core Solder
(2) Ground Splice Caps
(3) 10/32 Ground Screws
(2) 3½" Deep Wall Cases
100 Watt Light Bulb
Porcelain Light Fixture
(2) Wire Nuts for Two #12 Wires

EQUIPMENT: ¼" Drill Motor
25' Extension Cord

½" Wood Bit - Flat Boring
Propane Torch - Pencil Tip

TOOLS: Claw Hammer
Pocket Knife
6' Wooden Rule

Romex Stripper
8" Screwdriver
7" Side Cutters

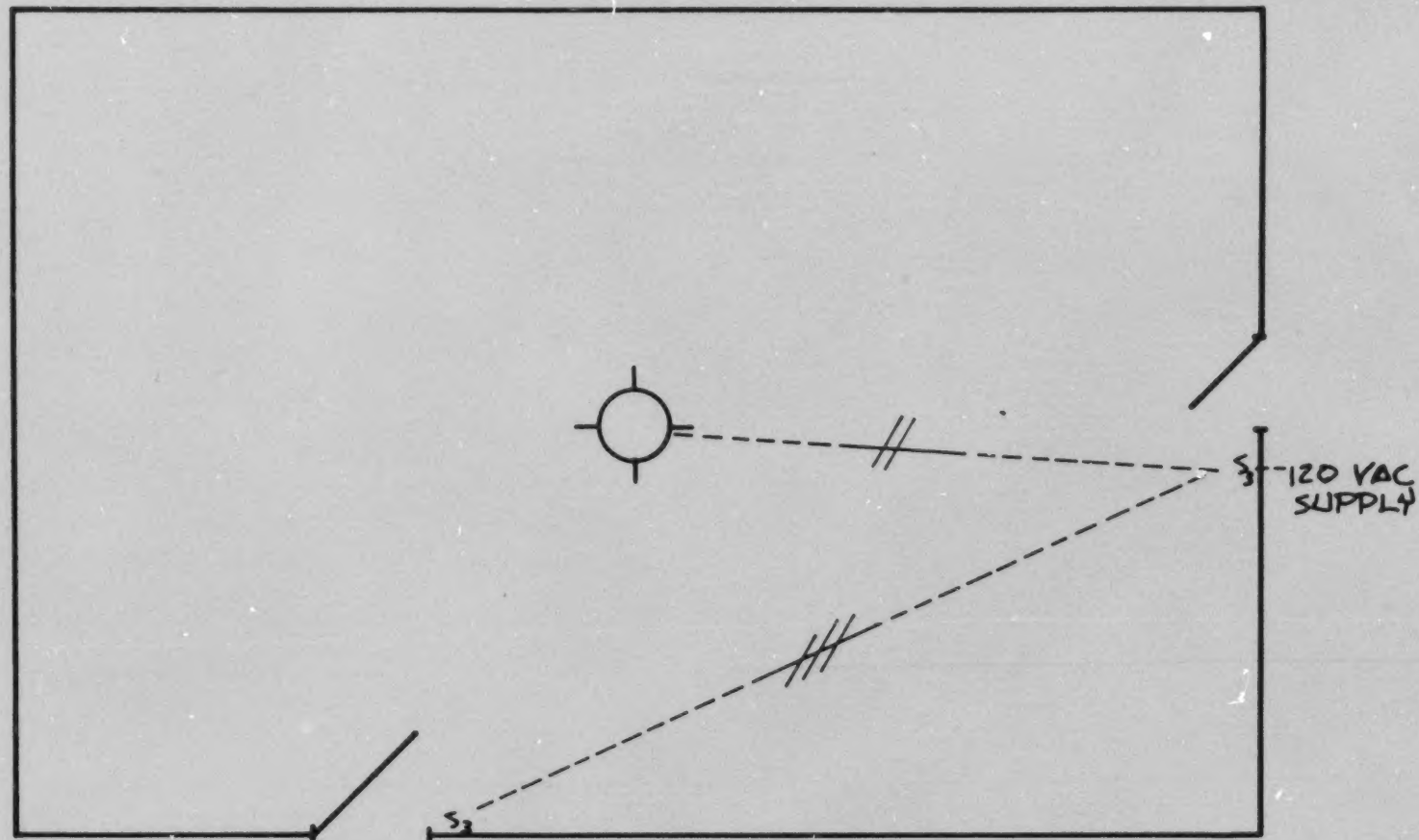
Wire Strippers
Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sketch a hook up of the job on the back of the job sheet.	. IL-2-19
2. Install the wall cases and light bar hanger.	. SC-2-14, SC-2-25
3. Place the bit in the chuck and drill the holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove the K.O.'s from the boxes.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice caps.	. SC-2-24
10. Strip the wires.	. SC-2-3
11. Twist the taps.	. SC-2-7, IL-2-19

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
12. Light the torch.	. SC-2-9
13. Solder the taps.	. SC-2-10
14. Tape the taps.	. SC-2-12
15. Strip the ends of the conductors about 7/8".	. SC-2-3
16. Bend hooks on the wires.	. SC-2-22
17. Attach all wires.	. SC-2-23, IL-2-19

METHOD OF EVALUATION:

The instructor will check the sketch and quality of the finished job.



SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
ONE LIGHT CONTROLLED BY TWO THREE-WAY SWITCHES WITH FEED TO SWITCH		
DRAWING NUMBER		D-2-38 107

JOB: Install One Light Controlled by
Two Three-way Switches with Feed
To The Light

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-39

UNIT II: Wiring Methods

DRAWING NO: D-2-39

COURSE: Electrical Occupations

MATERIAL:	Plastic Tape	100 Watt Light Bulb
	4" Round Box	Rosin Core Solder
	12-3 W/G Romex	(3) 10/32 Ground Screws
	12-2 W/G Romex	(2) 3½" Deep Wall Cases
	(5) Romex Staples	(2) Ground Splice Caps
	(2) Switch covers	Porcelain Light Fixture
	(6) 8 Penny Nails	(2) Wire Nuts for 2 #12 Wires

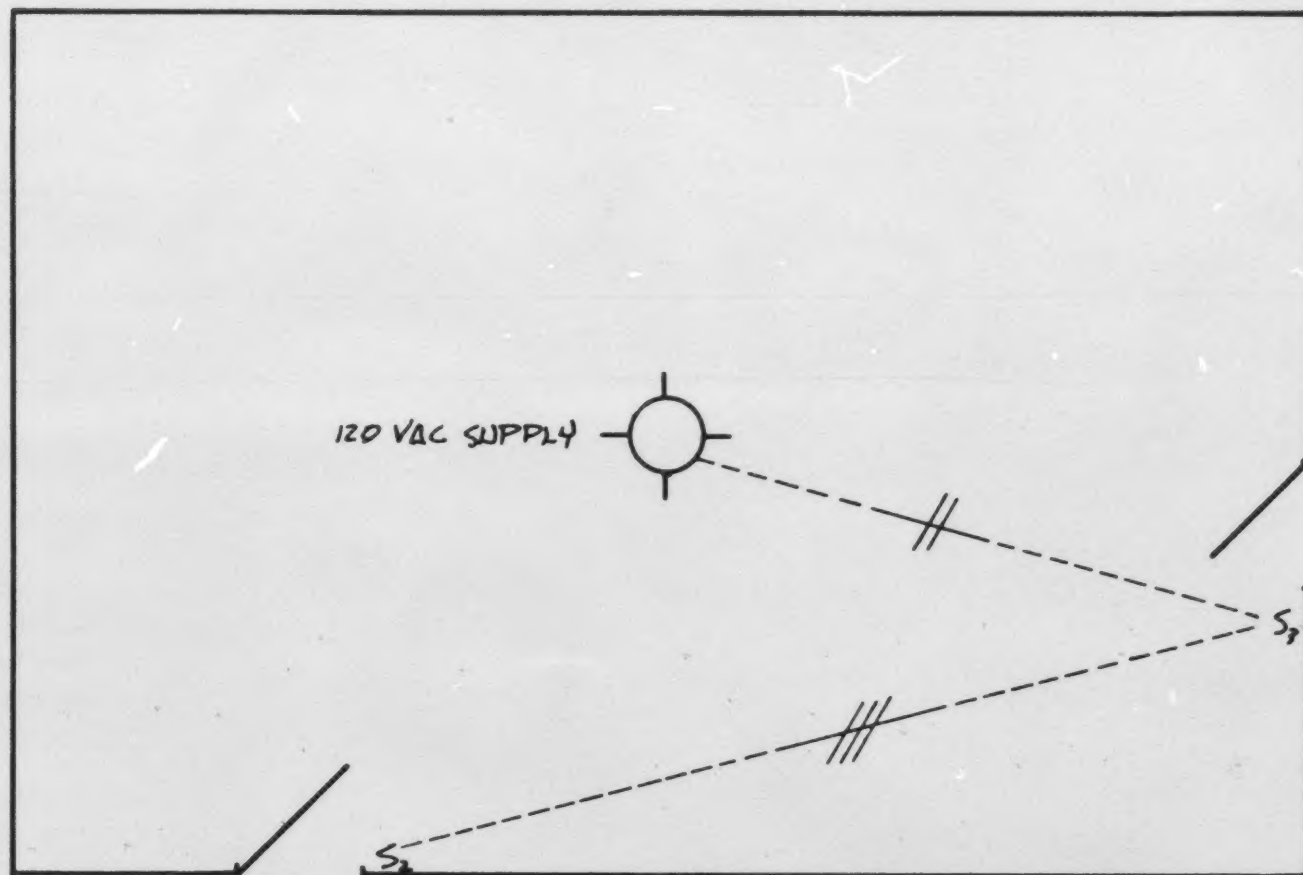
TOOLS:	Claw Hammer	Romex Stripper	
	Pocket Knife	8" Screwdriver	Wire Strippers
	6' Wooden Rule	7" Side Cutters	Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install the wall cases.	. SC-2-14, IL-2-20
2. Install the light bar hangers.	. SC-2-25
3. Drill holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove the K.O.'s from the boxes.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice caps.	. SC-2-24
10. Strip the wires.	. SC-2-6
11. Twist the taps.	. SC-2-4, IL-2-20
12. Light the torch.	. SC-2-9
13. Solder the taps.	. SC-2-10
14. Tape the taps.	. SC-2-12

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
15. Strip the ends of the conductors about 7/8".	. SC-2-3
16. Bend hooks on the wires.	. SC-2-22
17. Attach all wires.	. SC-2-23, IL-2-20

METHOD OF EVALUATION:

The instructor will check the finished work.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
ONE LIGHT CONTROLLED BY TWO THREE-WAY SWITCHES WITH FEED TO LIGHT		
		DRAWING NUMBER
		D-2-39 111

JOB: Install One Light Controlled by
Two Three-way Switches with Feed
to the Switch

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-40

COURSE: Electrical Occupations

DRAWING NO: D-2-40

MATERIAL: (5) Romex Staples
(2) Switch Covers
(6) 8 Penny Nails
14' 12-3 W/G Romex
10' 12-2 W/G Romex
(3) 10/32 Ground Screws
(2) 3½" Deep Wall Cases

Plastic Tape
4" Round Box
Rosin Core Solder
100 Watt Light Bulb
(2) Ground Splice Caps
Porcelain Light Fixture
(2) Wire Nuts for Two #12 Wires

EQUIPMENT: ¼" Drill Motor
25' Extension Cord

½" Wood Bit - Flat Boring
Propane Torch - Pencil Tip

TOOLS: Claw Hammer
Pocket Knife
8" Screwdriver

Romex Stripper
Wire Strippers
6' Wooden Rule

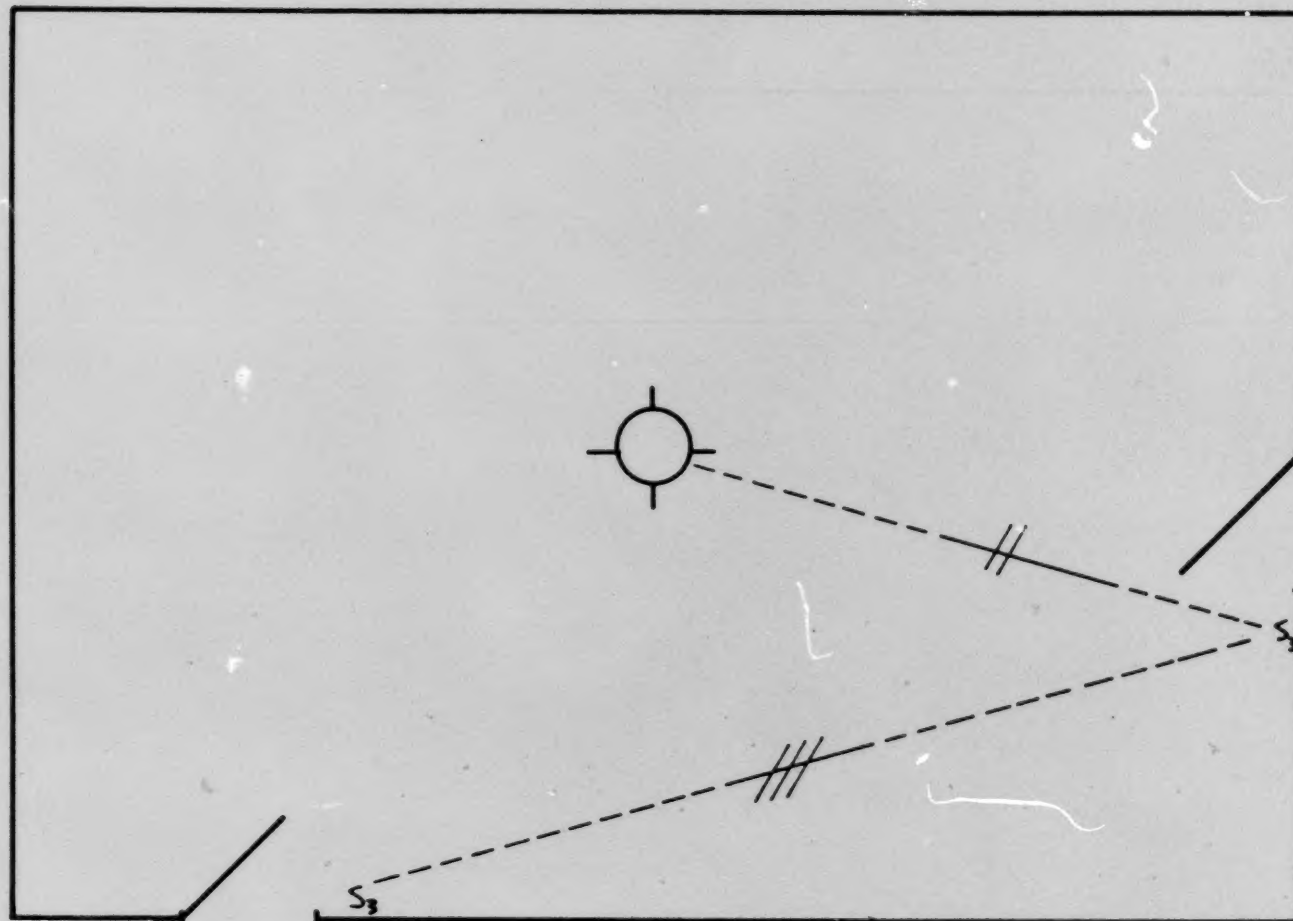
7" Side Cutters
Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sketch a hook up of the job on the back of the job sheet.	. IL-2-20
2. Install the wall cases and light bar hangers.	. SC-2-14, SC-2-25
3. Place the bit in the chuck and drill the holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove the K.O.'s from the boxes.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice caps.	. SC-2-24
10. Strip the wires.	. SC-2-6
11. Twist the taps.	. SC-2-4, IL-2-20
12. Light the torch.	. SC-2-9
13. Solder the taps.	. SC-2-10

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
14. Tape the taps.	. SC-2-12
15. Strip the ends of the conductors about 7/8".	. SC-2-3
16. Bend hooks on the wires.	. SC-2-22
17. Attach all wires.	. SC-2-23, IL-2-20

METHOD OF EVALUATION:

The instructor will check the finished job for accuracy and neatness.



120 VAC
SUPPLY

114

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
ONE LIGHT CONTROLLED BY TWO THREE-WAY SWITCHES WITH FEED TO THE SWITCH		
		DRAWING NUMBER
		D-2-40 115

JOB: Install Four Duplex Receptacles
on the Same Circuit

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-41

COURSE: Electrical Occupations

DRAWING NO: D-2-41

MATERIAL: Plastic Tape
Rosin Core Solder
(4) Duplex Covers
(3) Ground Splice Caps
(4) 3½" Deep Wall Cases

12-2 W/G Romex
(4) Romex Staples
(4) Duplex Outlets
(4) 10/32 Ground Screws
(8) 8 Penny Duplex Nails

EQUIPMENT: ¼" Drill Motor
Propane Torch

25' Extension Cord
½" Wood Bit - Flat Boring

TOOLS: Claw Hammer
Pocket Knife
7" Side Cutters

8" Screwdriver
Romex Stripper
Wire Strippers

6' Wooden Rule
Ground Splice Crimper

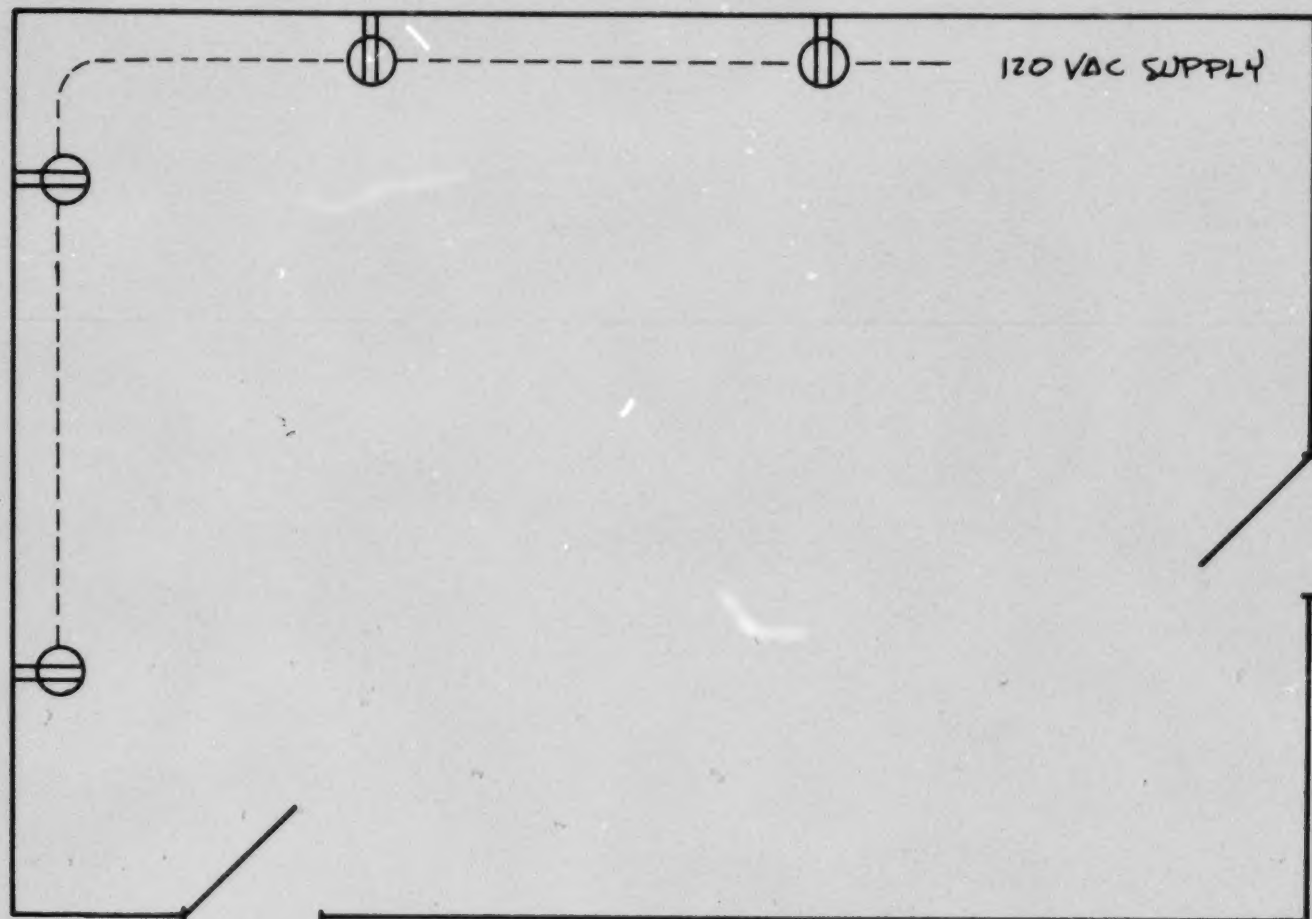
COMPETENCE - PROCEDURE/STEPS The student will be able to;	TEACHING/LEARNING ACTIVITIES
1. Mount the wall cases.	. SC-2-14, IL-2-2, IL-2-4
2. Drill holes in studs.	. SC-2-16
3. Pull the wire in.	. SC-2-17
4. Strip about 8" of Romex.	. SC-2-20
5. Remove K.O. from box.	. SC-2-19
6. Clamp Romex to wall cases.	. SC-2-21
7. Staple Romex.	. SC-2-18
8. Make up taps leaving a 6" lead.	. SC-2-7, IL-2-4
9. Light the torch.	. SC-2-9
10. Solder the taps.	. SC-2-10
11. Tape the taps.	. SC-2-12
12. Install ground splice caps.	. SC-2-24
13. Strip the ends of the conductors about 7/8".	. SC-2-3
14. Bend hooks on the conductors.	. SC-2-22

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
15. Attach ground wire to boxes and devices.	. IL-2-5
16. Attach insulated conductor to devices.	. SC-2-23, IL-2-4

METHOD OF EVALUATION:

The instructor will inspect the finished job.

143



118

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
FOUR DUPLEX RECEPTACLES ON THE SAME CIRCUIT		
		DRAWING NUMBER
		D-2-41 119

JOB: Install A Single Pole Switch
Controlling Two Lights with a Feed
to the Switch Box

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: (8) Staples
Plastic Tape
12-2 W/G Romex
Rosin Core Solder
(2) 4" Round Boxes
(2) 100 Watt Bulbs
(2) Ground Splice Caps

EQUIPMENT: Propane Torch
 $\frac{1}{4}$ " Drill Motor

TOOLS: Claw Hammer
Pocket Knife
7" Side Cutters

8" Screwdriver
Romex Stripper
Wire Strippers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-42

DRAWING NO: D-2-42

(2) Light Bar Hangers
 $3\frac{1}{2}$ " Deep Wall Case
Single Pole Switch
Switch Plate Cover
(3) 10/32 Ground Screws
(6) 8 Penny Duplex Nails
(2) 4" Porcelain Plain Lights

25' Extension Cord
 $\frac{1}{2}$ " Wood Bit - Flat Boring

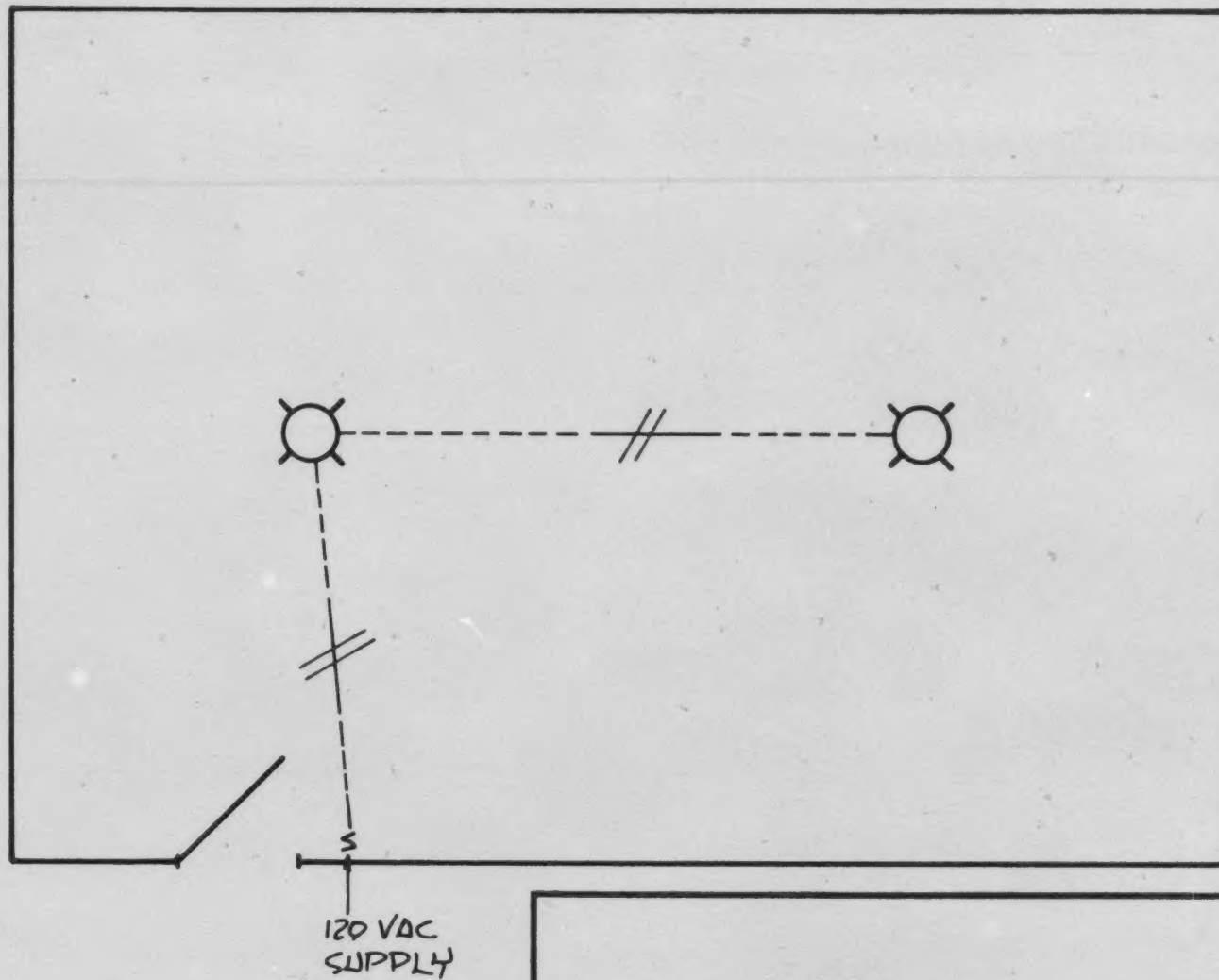
6' Wooden Rule
Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install light bar hangers.	. SC-2-25, IL-2-2
2. Install the wall case for the switch.	. SC-2-14, IL-2-14
3. Drill holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove K.O. from box.	. SC-2-19
8. Clamp the Romex to the box.	. SC-2-21
9. Install ground splice caps.	. SC-2-24
10. Twist taps.	. SC-2-7, IL-2-14
11. Light the torch.	. SC-2-9
12. Solder the taps.	. SC-2-10
13. Tape the taps.	. SC-2-12

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
14. Strip the end of the conductors about 7/8".	. SC-2-3
15. Bend hooks on wires.	. SC-2-22
16. Attach all wires to devices.	. SC-2-23, IL-2-14

METHOD OF EVALUATION:

The instructor will check the quality of the finished job.



122

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
SINGLE POLE SWITCH CONTROLLING TWO LIGHTS WITH FEED TO THE SWITCH BOX		
		DRAWING NUMBER
		D-2-42 123

JOB: Install Five Receptacles with Two
Three-way Switches Controlling
the Top Half of Two Receptacles

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-43

UNIT II: Wiring Methods

DRAWING NO: D-2-43

COURSE: Electrical Occupations

MATERIAL: 28' 12-3 W/G Romex
40' 12-2 W/G Romex
(15) Romex Staples
(7) 10/32 Ground Screws
(7) 3½" Deep Wall Cases
(2) Switch Covers
(21) 8 Penny Nails

Plastic Tape
Rosin Core Solder
(7) Ground Splice Caps
(5) Receptacles
(5) Receptacle Covers
(2) 3-way Switches
(2) Wire Nuts for Two #12 Wires

EQUIPMENT: ¼" Drill Motor
25' Extension Cord

½" Wood Bit - Flat Boring
Propane Torch - Pencil Tip

TOOLS: Claw Hammer
Pocket Knife
7" Side Cutters

8" Screwdriver
Wire Strippers
Romex Stripper

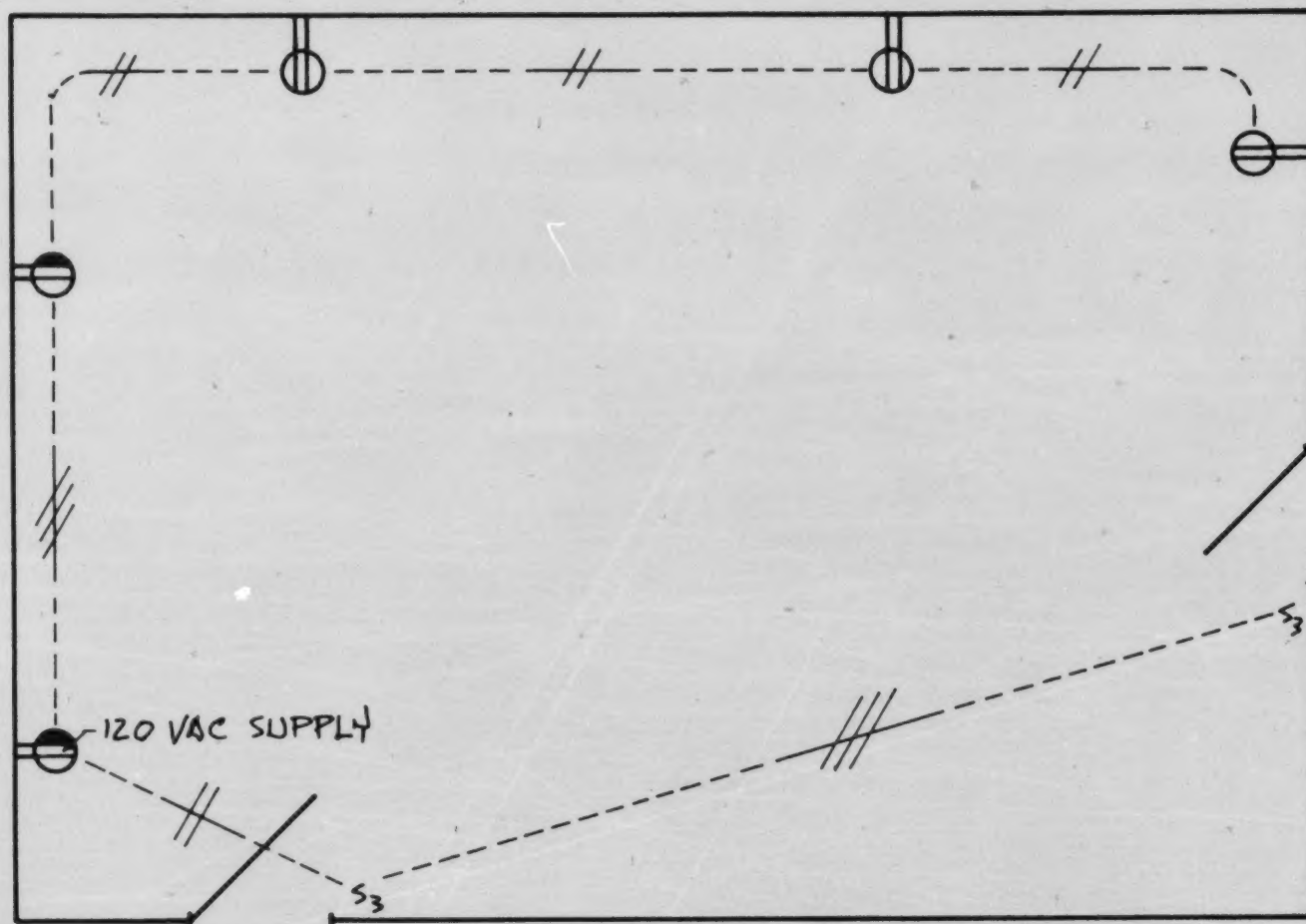
6' Wooden Rule
6' Wooden Rule
Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sketch a hook up of the job on the back of the job sheet.	. IL-2-4
2. Install the wall cases.	. SC-2-14
3. Place the bit in the chuck and drill holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove the K.O. from the box.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Twist the taps.	. SC-2-7, IL-2-4
10. Light the torch.	. SC-2-9
11. Solder the taps.	. SC-2-10

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
12. Tape the taps.	. SC-2-12
13. Strip the end of the conductors about 7/8".	. SC-2-3
14. Bend hooks on the wires.	. SC-2-22
15. Attach all wires.	. SC-2-23, IL-2-4

METHOD OF EVALUATION:

The instructor will check the accuracy and neatness of sketch and job.



126

SCALE:		APPROVED BY:	DRAWN BY
DATE:			REVISED
FIVE RECEPTACLES WITH TWO THREE-WAY SWITCHES CONTROLLING THE TOP HALF OF TWO RECEPTACLES			
			DRAWING NUMBER D-2-43 127

JOB: Install a 175 Watt Mercury Vapor
Light

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-44

COURSE: Electrical Occupations

DRAWING NO: D-2-44

MATERIAL: (2) Wire Nuts ½" Romex Connector
(9) Romex Staples 175 Watt Mercury Light Fixture

EQUIPMENT: ¼" Drill Motor
3/4" Drill Bit
25' Extension Cord

TOOLS: Knife 6" Screwdriver
Hammer 12" Crescent Wrench
6' Wooden Rule 7" Side Cutting Pliers

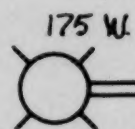
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Install the light according to the manufacturer's specifications.

METHOD OF EVALUATION:

The instructor will inspect the finished job.



120 VAC SUPPLY

155

129

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
175 WATT MERCURY VAPOR LIGHT		
		DRAWING NUMBER
		D-2-44 130

JOB: Install A Recessed Light Controlled
by Two Three-way Switches

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-45

COURSE: Electrical Occupations

DRAWING NO: D-2-45

MATERIAL: To be listed by the student

EQUIPMENT: $\frac{1}{4}$ " Drill Motor
 $\frac{1}{2}$ " Drill Motor
6' Step Ladder

TOOLS: Hammer 6" Screwdriver
Knife Romex Stripper
7" Side Cutters Wire Strippers

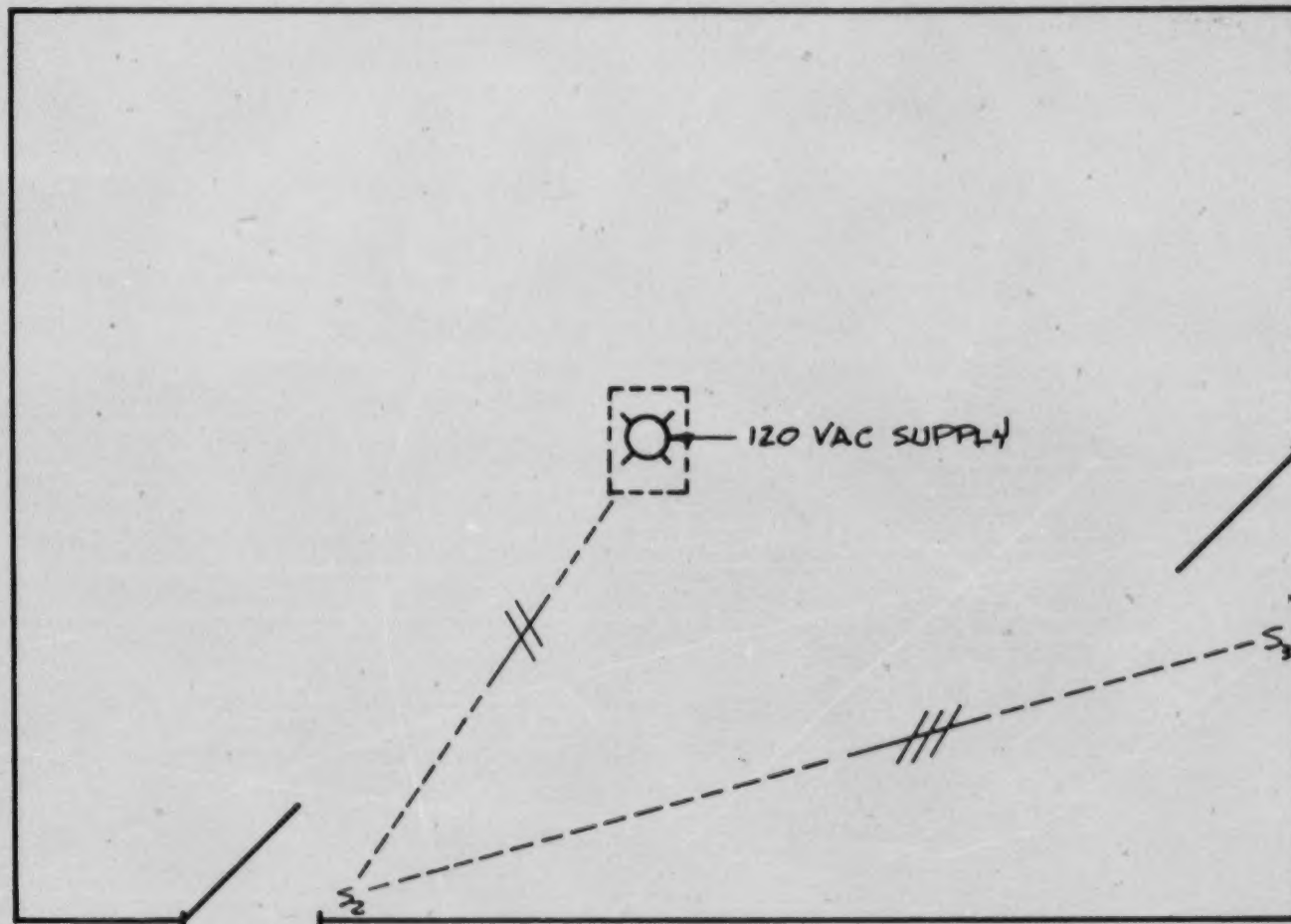
6' Wooden Rule
Splice Cap Crimpers
12' Steel Tape Rule

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount the recessed light in the middle of the room - the ceiling is to have 3/8" sheet rock on it.	NOTE: See manufacturer's specifications.
2. Mount the wall cases.	. SC-2-14
3. Install the wire.	. SC-2-17, IL-2-20
4. Make up the taps.	. SC-2-7, IL-2-20
5. Install the devices.	. SC-2-23, IL-2-20

METHOD OF EVALUATION:

The instructor will check for accuracy in:

1. listing materials needed.
2. job work.



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SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
A RECESSED LIGHT CONTROLLED BY TWO THREE-WAY SWITCHES		
		DRAWING NUMBER
		D-2-45133

JOB: Install A Fan Controlled by A
Single Pole Switch

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-46

COURSE: Electrical Occupations

DRAWING NO: D-2-46

MATERIAL: To be listed by the student

EQUIPMENT: $\frac{1}{4}$ " Drill Motor 6' Step Ladder
 $\frac{1}{2}$ " Drill Motor 25' Extension Cord

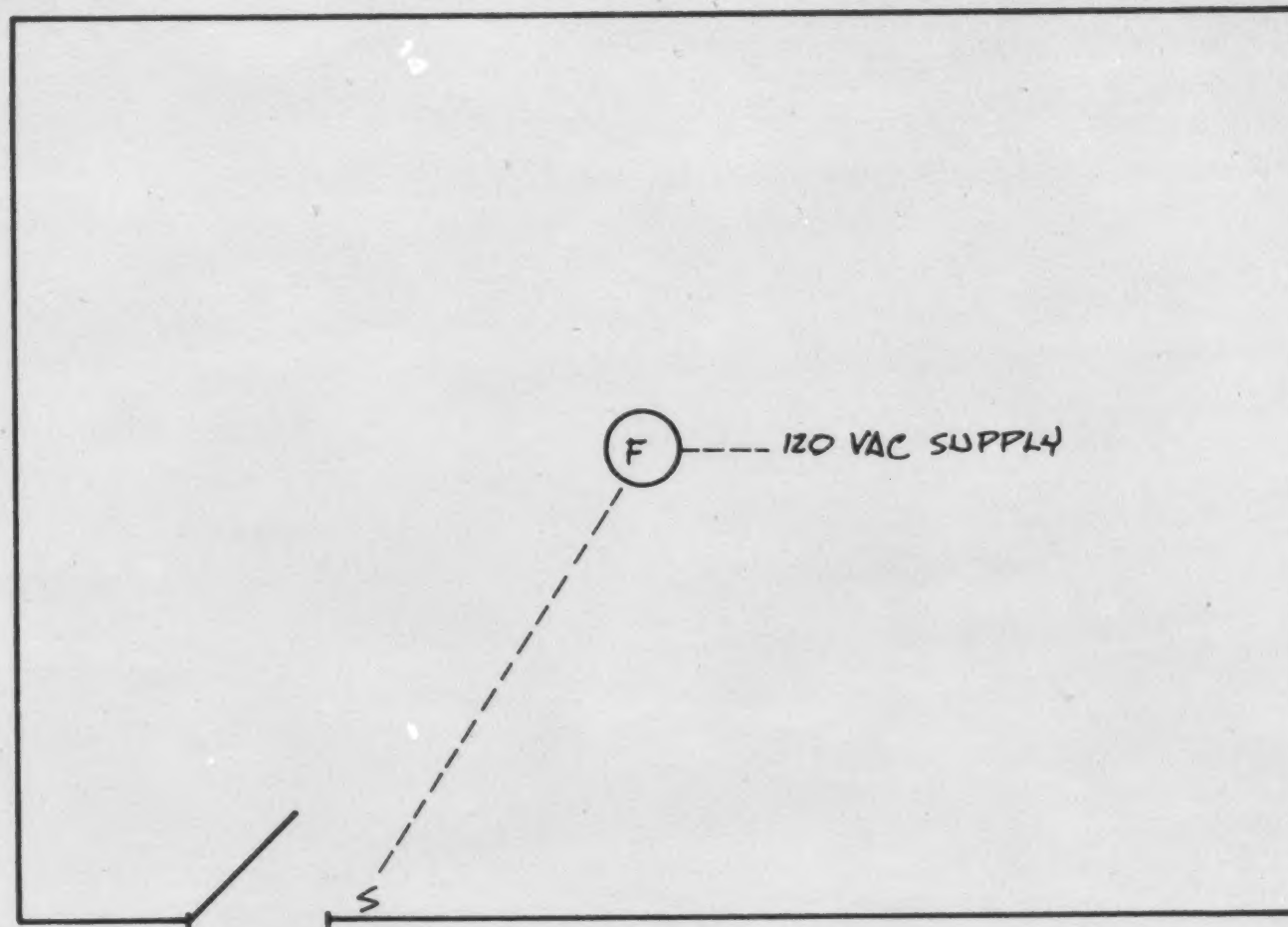
TOOLS: Knife 7" Side Cutters 6' Wooden Rule
Claw Hammer 6" Screwdriver 12' Steel Tape Rule
Romex Strippers Wire Strippers Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount the recessed fan - the ceiling is to have 3/8" sheet rock.	NOTE: See manufacturer's specifications.
2. Mount the wall case.	. SC-2-14
3. Install the wire.	. SC-2-16 through SC-2-21
4. Make up the taps.	. SC-2-3, SC-2-26, IL-2-8
5. Install the device.	. SC-2-23
6. Hook up to fuse or breaker box.	. SC-2-45, IL-2-45

METHOD OF EVALUATION:

The instructor will:

1. Check materials list.
2. Inspect finished job.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
A FAN CONTROLLED BY A SINGLE POLE SWITCH		
		DRAWING NUMBER
		D-2-46136

JOB: Install Two Fluorescent Lights
Controlled by Two Three-way
Switches

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-47

COURSE: Electrical Occupations

DRAWING NO: D-2-47

MATERIAL: To be listed by the student

EQUIPMENT: $\frac{1}{2}$ " Drill Bit 6' Step Ladder
 $\frac{1}{4}$ " Drill Motor 25' Extension Cord

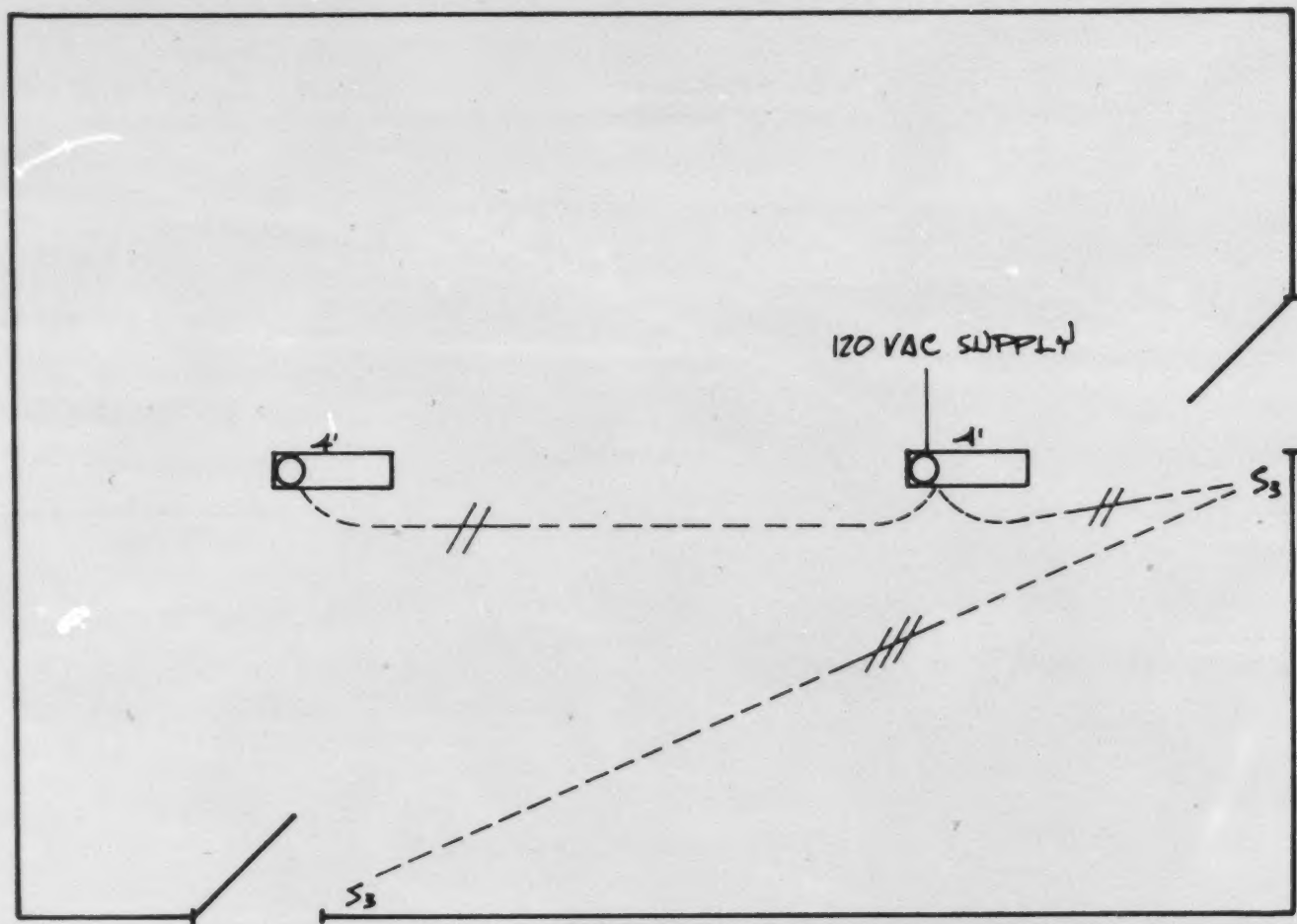
TOOLS: 7" Side Cutters Claw Hammer Ground Splice Crimpers
 Pocket Knife Romex Stripper Propane Torch
 8" Screwdriver Wire Strippers 6' Wooden Rule

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Draw a lay out of the location of the lights.	
2. Mount the lights.	. SC-2-41
3. Mount the wall cases.	. SC-2-14
4. Install the wire.	. SC-2-16 through SC-2-21
5. Make up connections.	. SC-2-3 . SC-2-6, SC-2-7 . SC-2-11 . SC-2-13 . SC-2-26 . IL-2-20
6. Install devices.	. SC-2-23
7. Hook up to fuse or breaker box.	. SC-2-45, IL-2-45, IL-2-46

METHOD OF EVALUATION:

The instructor will:

1. check materials list.
2. check drawing for accuracy and neatness.
3. inspect finished job.



SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
TWO FLUORESCENT LIGHTS CONTROLLED BY TWO THREE-WAY SWITCHES		
		DRAWING NUMBER
		D-2-47

JOB: Install One Light Controlled by
Two Three-way Switches and One Four-
way Switch with Feed to the Switch

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-48

UNIT II: Wiring Methods

DRAWING NO: D-2-48

COURSE: Electrical Occupations

MATERIAL: 4" Round Box
Light Bar Hanger
100 Watt Light Bulb
(3) 3½" Deep Wall Cases
(2) 3-way Switches
4-way Switch
(3) Switch Covers

12-2 W/G Romex
12-3 W/G Romex
(5) Romex Staples
(3) Ground Splice Caps
(4) 10/32 Ground Screws
Porcelain Plain Light Fixture

EQUIPMENT: ¼" Drill Motor
25' Extension Cord

½" Wood Bit - Flat Boring
Propane Torch - Pencil Tip

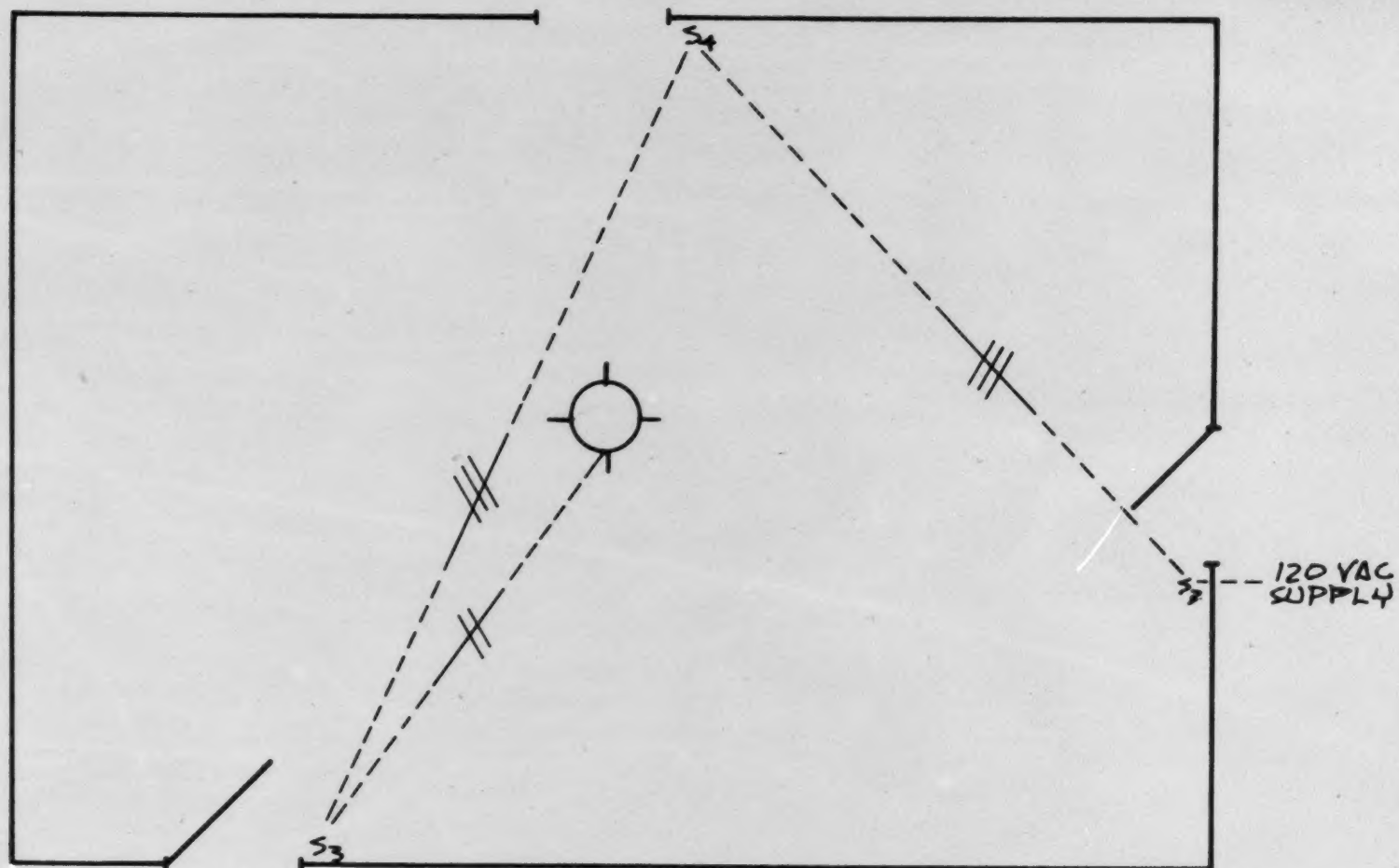
TOOLS: 7" Side Cutters
Pocket Knife
8" Screwdriver
Wire Strippers

Ground Splice Crimpers
Romex Stripper
6' Step Ladder
6' Wooden Rule

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install the light bar hanger.	. SC-2-25, IL-2-22
2. Install the wall cases.	. SC-2-14
3. Install the wire.	. SC-2-17
4. Make up the connections.	. SC-2-7, IL-2-22
5. Install the devices.	. SC-2-23

METHOD OF EVALUATION:

The instructor will inspect the finished job.



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SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
ONE LIGHT CONTROLLED BY TWO THREE-WAY SWITCHES AND ONE FOUR-WAY SWITCH WITH FEED TO THE SWITCH		
		DRAWING NUMBER
		D-2-48 142

JOB: Install One Light Controlled by
Two Three-way Switches and Two
Four-way Switches with Feed to
the Switch

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-49

UNIT II: Wiring Methods

DRAWING NO: D-2-49

COURSE: Electrical Occupations

MATERIAL: 4" Round Box
Light Bar Hanger
Porcelain Plain Light
100 Watt Bulb
(4) 3½" Deep Wall Cases
(2) 3-way Switches
(2) 4-way Switches
(4) Switch Covers
12-2 W/G Romex
12/3 W/G Romex
(5) Romex Staples
(3) Ground Splice Caps
(4) 10/32 Ground Screws

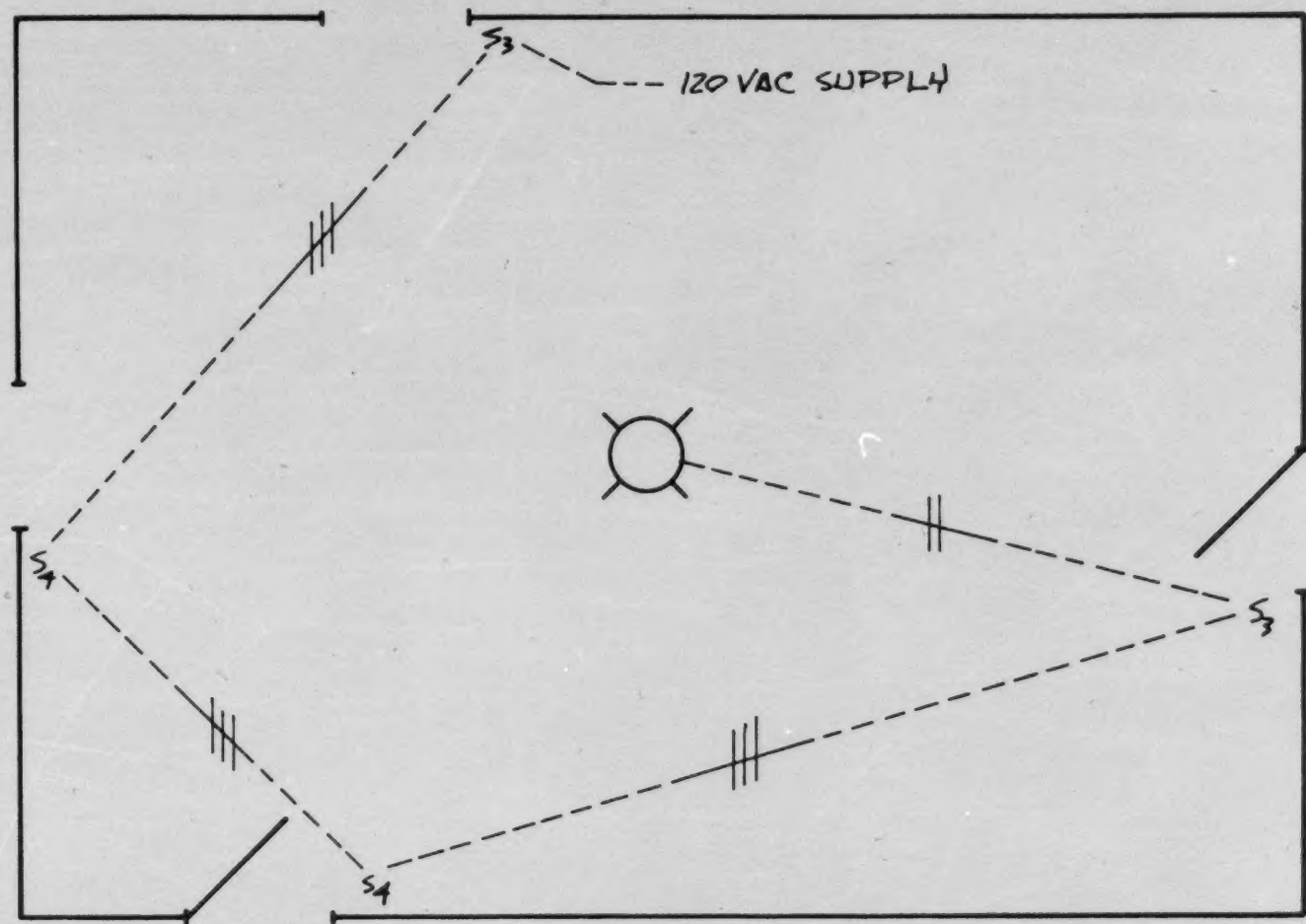
EQUIPMENT: ¼" Drill Motor
25' Extension Cord
½" Wood Bit - Flat Boring
Propane Torch - Pencil Tip

TOOLS: 7" Side Cutters
Pocket Knife
8" Screwdriver
Claw Hammer
Wire Strippers
Ground Splice Crimpers
6' Wooden Rule
6' Step Ladder
Romex Stripper

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install the light bar hanger.	. SC-2-25, IL-2-22
2. Install the wall cases.	. SC-2-14
3. Install the wire.	. SC-2-17
4. Make up the connections.	. SC-2-7, IL-2-22
5. Install the devices.	. SC-2-23

METHOD OF EVALUATION:

The instructor will check finished work.



SCALE:

APPROVED BY:

DRAWN BY

DATE:

REVISED

ONE LIGHT CONTROLLED BY TWO THREE-WAY SWITCHES AND TWO FOUR-WAY SWITCHES WITH FEED TO THE SWITCH

DRAWING NUMBER

D-2-49 145

JOB: Install One Light Controlled by
Two Three-way Switches and One
Four-way Switch with Feed to the
Light

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-50

UNIT II: Wiring Methods

DRAWING NO: D-2-50

COURSE: Electrical Occupations

MATERIAL: 4" Round Box
Light Bar Hanger
100 Watt Light Bulb
Porcelain Plain Light
(3) 3½" Deep Wall Cases
(3) Ground Splice Caps
(4) 10/32 Ground Screws

(2) 3-way Switches
4-way Switch
(3) Switch Covers
(5) Romex Staples
12-2 W/G Romex
12-2 W/G Romex

EQUIPMENT: ½" Drill Motor
25' Extension Cord

½" Drill Bit - Flat Boring
Propane Torch - Pencil Tip

TOOLS: Claw Hammer
Pocket Knife
6' Step Ladder

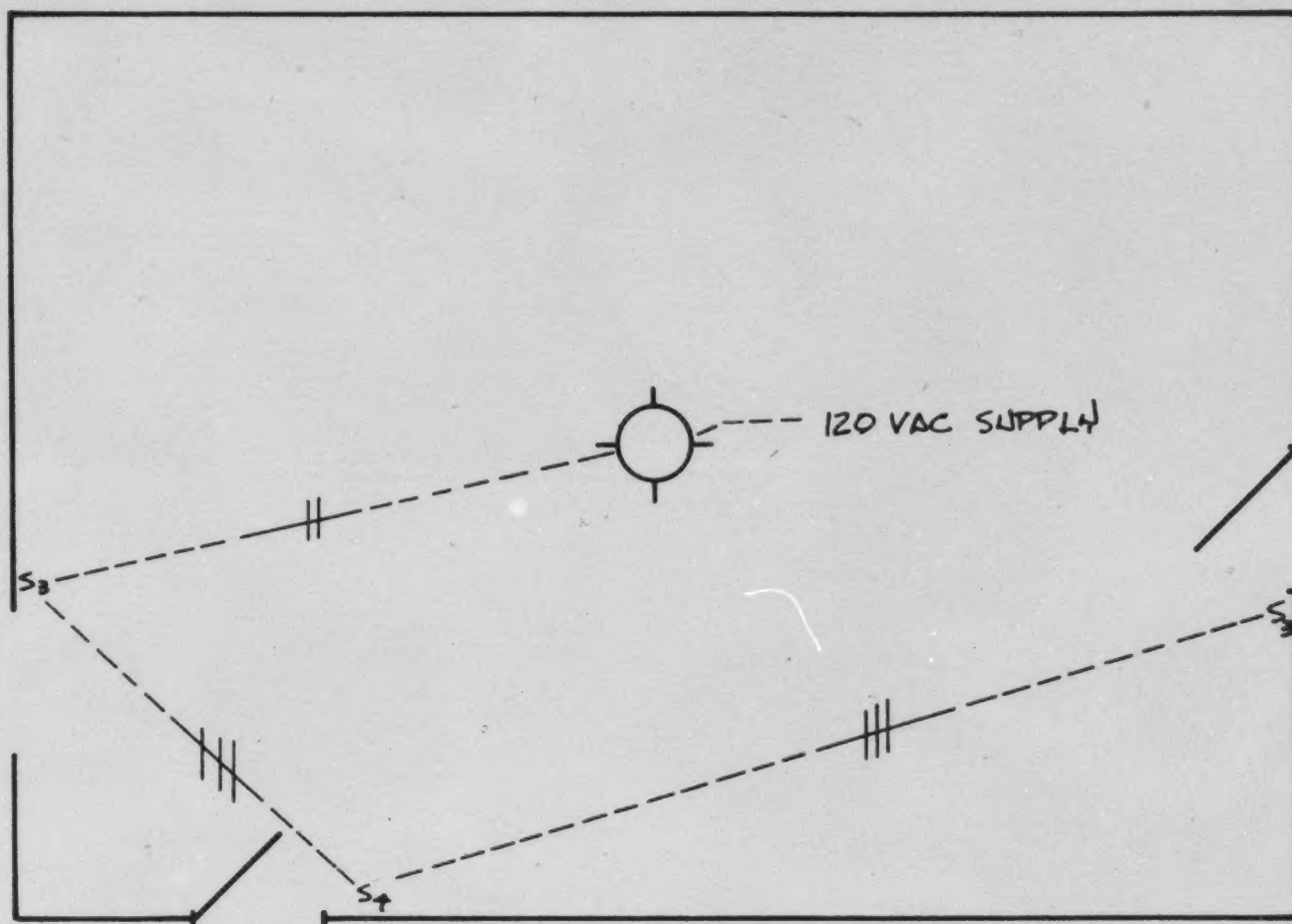
8" Screwdriver
Wire Strippers
6' Wooden Rule

7" Side Cutters
Romex Strippers
Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install the light bar hanger.	. SC-2-25, IL-2-23
2. Install the wall cases.	. SC-2-14
3. Install the wire.	. SC-2-17
4. Make up connections.	. SC-2-7
5. Install devices.	. SC-2-23, IL-2-23

METHOD OF EVALUATION:

The instructor will check the finished job.



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SCALE:

APPROVED BY:

DRAWN BY

DATE:

REVISED

ONE LIGHT CONTROLLED BY TWO THREE-WAY SWITCHES AND ONE FOUR-WAY SWITCH WITH FEED TO THE LIGHT

DRAWING NUMBER

D-2-50 148

JOB: Install a Delayed Switch Controlling
One Light with Feed to the Switch

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-51

COURSE: Electrical Occupations

DRAWING NO: D-2-51

MATERIAL: Light Bar Hanger
(2) 10/32 Ground Screws
100 Watt Light Bulb
3½" Deep Wall Case
Delayed Single Pole Switch
Switch Plate Cover
Ground Splice Cap

4" Round Box
12-2 W/G Romex
4" Porcelain Plain Light Fixture
(7) Staples
(4) 8 Penny Nails
Plate Tape
Wire Nut

EQUIPMENT: ¼" Drill Motor
½" Wood Bit - Flat Boring

TOOLS: Claw Hammer
Pocket Knife
Romex Stripper
Wire Strippers

6' Wooden Rule
7" Side Cutter
8" Screwdriver
Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install the light bar hanger.	. SC-2-25
2. Install the wall case for the switch.	. SC-2-14, IL-2-2
3. Drill the holes in the studs.	. SC-2-16
4. Pull the wire in.	. SC-2-17
5. Strip the Romex about 8".	. SC-2-20
6. Staple the Romex.	. SC-2-18
7. Remove the K.O. from the box.	. SC-2-19
8. Clamp the Romex to the boxes.	. SC-2-21
9. Install the ground splice cap.	. SC-2-24
10. Install the wire nuts.	. SC-2-26, IL-2-8
11. Strip the end of the conductors about 7/8".	. SC-2-3
12. Bend hooks on the wires.	. SC-2-22

COMPETENCE - PROCEDURE/STEPS

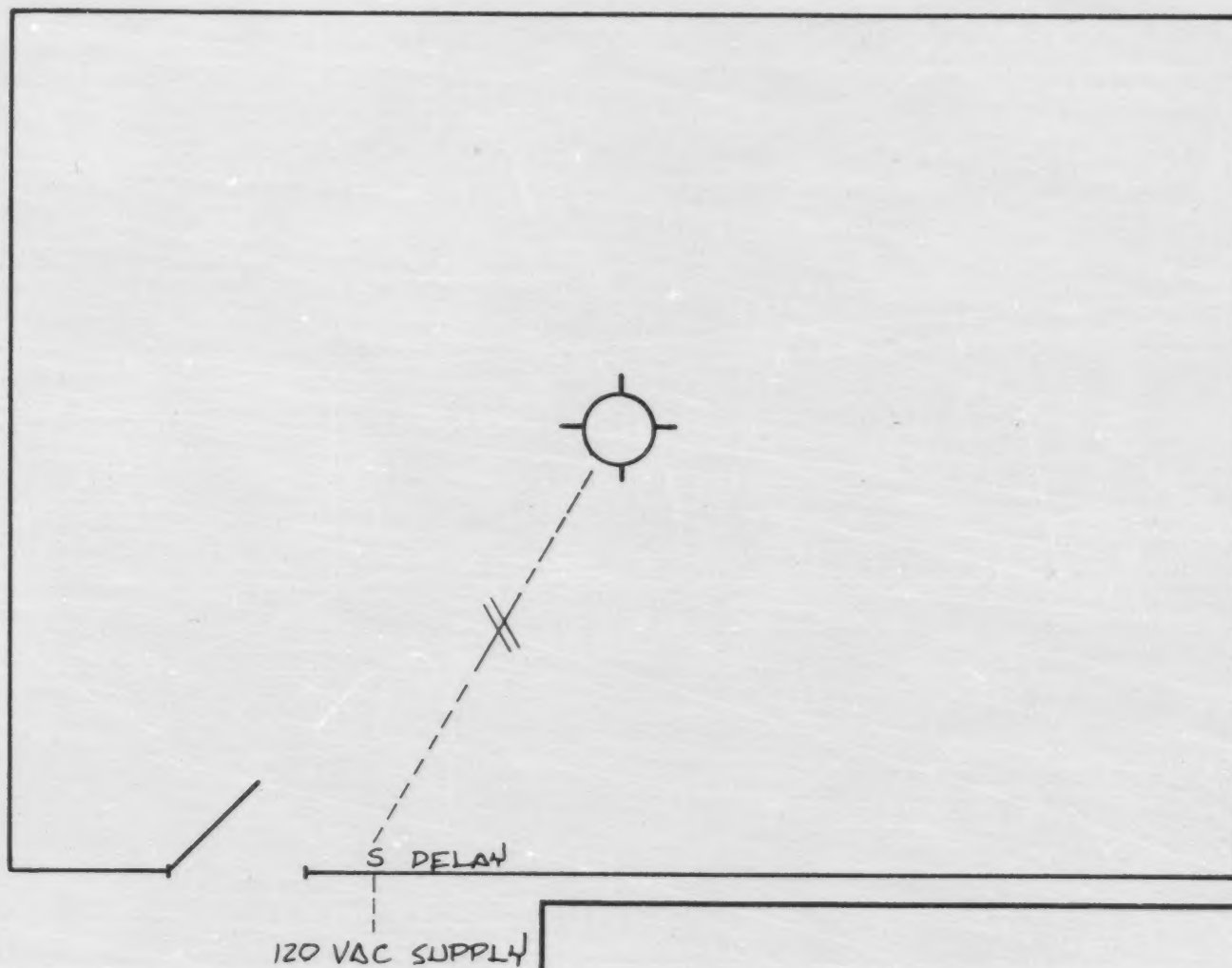
TEACHING/LEARNING ACTIVITIES

13. Attach all wires.

. SC-2-23, IL-2-8

METHOD OF EVALUATION:

The instructor will check the work when finished.



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SCALE:

APPROVED BY:

DRAWN BY

DATE:

REVISED

DELAYED SWITCH CONTROLLING ONE LIGHT WITH FEED TO THE SWITCH

DRAWING NUMBER

D-2-51 152

JOB: Install One Light Controlled by
Two Three-way Switches - Using B.X.
Cable with the Feed to the Light

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-52

COURSE: Electrical Occupations

DRAWING NO: D-2-52

MATERIAL: Light Bar Hanger
4" Round B.X. Box
(2) 3½" Deep B.X. Wall Cases
100 Watt Light Bulb
(6) Staples

6' 12-2 B.X. Cable
5' 12-3 B.X. Cable
(2) Three-way Switches
Porcelain Plain Light
(2) Switch Covers - Plastic

EQUIPMENT: ¼" Drill Motor
25' Extension Cord

5/8" Wood Bit - Flat Boring
Propane Torch - Pencil Tip

TOOLS: Wire Stripper
6' Wood Rule
B.X. Cutters
7" Side Cutters

Pocket Knife
Claw Hammer
8" Screwdriver

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. To be listed by the student.

METHOD OF EVALUATION:

The instructor will:

1. check drawing when completed.
2. check the list of procedures.
3. inspect the finished job.



NOTE: STUDENT COMPLETE DRAWING
AND SHOW TO INSTRUCTOR
BEFORE YOU START THIS
JOB.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
ONE LIGHT CONTROLLED BY TWO THREE-WAY SWITCHES - USING B.X. CABLE WITH THE FEED TO THE LIGHT		
		DRAWING NUMBER D-2-52

JOB: Install Five Receptacles in a
Sheet Rock Wall

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-53

COURSE: Electrical Occupations

DRAWING NO: D-2-53

MATERIAL: (10) Box Holders
(20) Lath Nails
25' 12-2 W/G Romex
(5) 3½" Deep Wall Cases
(5) Duplex Receptacles

(4) Ground Splice Caps
3/8" Sheet Rock - 4' x 8'
(5) Duplex Receptacle Covers
(5) 10/32 Ground Screws

EQUIPMENT: ¼" Drill Motor
25' Extension Cord

¼" Drill Bit - Flat Boring
Propane Torch - Pencil Tip

TOOLS: Wire Strippers Key Hole Saw
Romex Stripper Pocket Knife
6' Wooden Rule Claw Hammer

7" Side Cutters
8" Screwdriver
Ground Splice Crimpers

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Install the receptacles as per instructor specifications for location.
2. Procedure listed by the student.

METHOD OF EVALUATION:

The instructor will:

1. check drawing for accuracy and neatness.
2. check the procedures listed.
3. inspect the job when finished.



NOTE: STUDENT COMPLETE DRAWING
AND SHOW TO INSTRUCTOR
BEFORE YOU START THIS
JOB.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
FIVE RECEPTACLES IN A SHEET ROCK WALL		
		DRAWING NUMBER
		D-2-53

JOB: Install Two Fluorescent Lights
Controlled by One Single Pole
Switch; Switch Installed in a
Sheet Rock Wall

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-54

UNIT II: Wiring Methods

DRAWING NO: D-2-54

COURSE: Electrical Occupations

MATERIAL: Single Pole Switch 3/8" Sheet Rock - 4' x 8'
Switch Cover (3) 10/32 Ground Screws
(2) Box Holders (2) Fluorescent Lights
3 1/2" Deep Wall Case (2) Ground Splice Caps
(2) Lath Nails 25' 12-2 W/G Romex

EQUIPMENT: 1/4" Drill Motor 1/2" Drill Bit - Flat Boring
25' Extension Cord Propane Torch - Pencil Tip

TOOLS: Claw Hammer 6' Wooden Rule Ground Splice Crimpers
Pocket Knife 7" Side Cutters 8" Screwdriver
Key Hole Saw Wire Strippers 6' Step Ladder
Romex Stripper

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Install the job as per instructor specifications for location.
2. Procedure to be listed by the student.

METHOD OF EVALUATION:

The instructor will check:

1. Drawing.
2. List of procedures.
3. Finished job.



NOTE: STUDENT COMPLETE DRAWING
AND SHOW TO INSTRUCTOR
BEFORE YOU START THIS
JOB.

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SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
TWO FLUORESCENT LIGHTS CONTROLLED BY ONE SINGLE POLE SWITCH; SWITCH INSTALLED IN A SHEET ROCK WALL		
		DRAWING NUMBER D-2-54

JOB: Install A 100 Ampere Service to
the Side of a House (Fuse Box)

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-55

COURSE: Electrical Occupations

MATERIAL:	(14) Staples	24" x 30" x 3/4" Plywood Panel
	4" Air Seal Putty	14' 100 Amp Aluminum Cable
	Ground Clamp	(9) 100 Amp Cable Straps
	1 1/2" Connector	(2) 1 1/4" Weatherproof Connectors
	100 Amp Weatherhead	(20) #12 x 1 1/4" Pan Head Screws
	100 Amp Meter Socket	100 Amp Square D Fuse Panel
	14' #6 Bare Ground Wire	(4) 1 1/2" Flat Head Screws

EQUIPMENT:	Hack Saw	
	2' Level	1/2" Drill Motor
	Chalkline	Drill Bit

TOOLS:	Pocket Knife	
	Claw Hammer	7" Side Cutters
	8" Screwdriver	10" Screwdriver

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Strip 24" of 100 amp cable.	. SC-2-36
2. Braid the neutral conductor.	. SC-2-38
3. Install the weatherhead.	. SC-2-39
4. Mount the meter socket.	. SC-2-41, IL-2-25
5. Snap the chalkline where the cable is to be run.	. SC-2-37
6. Mount the weatherhead.	. SC-2-41
7. Cut the cable off long enough to reach the lugs in the meter socket.	. SC-2-35
8. Install the weatherproof connector in the meter socket.	. SC-2-43
9. Strip the cable.	. SC-2-36
10. Strap the cable.	. SC-2-40
11. Braid the neutral conductor.	. SC-2-38
12. Attach the wire to the meter socket lugs.	. SC-2-45, IL-2-30

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
13. Strip the cable.	. SC-2-36
14. Install the weatherproof connector.	. SC-2-43
15. Braid the neutral conductor.	. SC-2-38
16. Attach the wire to the lugs.	. SC-2-45, IL-2-30
17. Seal the weatherproof connectors.	. SC-2-44
18. Drill a hole for cable through the house.	. SC-2-16
19. Push the cable through the hole.	. SC-2-17
20. Strap the cable below the meter socket.	. SC-2-40
21. Mount the plywood panel board.	. SC-2-41
22. Mount the fuse box.	. SC-2-41
23. Remove the 1½" K.O. from the box.	. SC-2-19
24. Install the 1½" connector.	. SC-2-29
25. Cut the cable off long enough.	. SC-2-35
26. Strip the cable to length.	. SC-2-36
27. Braid the neutral conductor.	. SC-2-38
28. Cut the wires to length.	. SC-2-35
29. Strip the wire the same length as the lug.	. SC-2-2
30. Connect the service wires to the lugs.	. SC-2-45, IL-2-25
31. Seal the hole where the cable enters the house with air seal in the same way you sealed the weatherproof connectors.	. SC-2-44
32. Install the ground clamp.	. IL-2-28
33. Connect the ground wire to the ground lug in the fuse box.	. SC-2-45, IL-2-28
34. Staple the ground wire.	. SC-2-18

METHOD OF EVALUATION:

The instructor will inspect the finished job.

JOB: Install a 100 Ampere Service to the Side of a House (100 Ampere Circuit Breaker Box)

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-56

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: (14) Staples (9) Amp Cable Straps
Ground Cable (4) 1½" Flat Head Screws
1½" Connector 14' 100 Amp Aluminum Cable
4" Air Seal Putty (20) #12 x 1¼" Pan Head Screws
100 Amp Weatherhead 24" x 30" x 3/4" Plywood Panel
100 Amp Meter Socket (2) 1½" Weatherproof Connectors
14' #6 Bare Ground Wire 100 Amp ITE Circuit Breaker Box

EQUIPMENT: ½" Drill Motor Hack Saw
Drill Bit Chalkline 2' Level

TOOLS: Claw Hammer 8" Screwdriver
Pocket Knife 10" Screwdriver 7" Side Cutters

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Strip 24" of 100 Amp cable.	. SC-2-36, IL-2-24
2. Braid the neutral conductor.	. SC-2-38
3. Install weatherhead.	. SC-2-39
4. Mount the meter socket.	. SC-2-41, IL-2-25
5. Snap the chalkline where the cable is to be run.	. SC-2-37, IL-2-25
6. Mount the weatherhead.	. SC-2-40, IL-2-25
7. Cut the cable off long enough to reach the lugs in the meter socket.	. SC-2-35
8. Install the weatherproof connector in the meter socket.	. SC-2-43, IL-2-25
9. Strip the cable.	. SC-2-36
10. Strap the cable.	. SC-2-40, IL-2-25
11. Braid the neutral conductor.	. SC-2-38
12. Attach the wire to the meter socket lugs.	. SC-2-38

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
13. Strip the cable.	. SC-2-36
14. Install the weatherproof connector.	. SC-2-43, IL-2-25
15. Braid the neutral conductor.	. SC-2-38
16. Attach the wire to the lugs.	. SC-2-45, IL-2-30
17. Seal the weatherproof connectors.	. SC-2-44
18. Drill a hole for cable through the house.	. SC-2-16
19. Push the cable through the hole.	. SC-2-17, IL-2-25
20. Strap the cable below the meter socket.	. SC-2-40
21. Mount the plywood panel board.	. SC-2-41
22. Mount the circuit breaker box.	. SC-2-41, IL-2-25
23. Remove the 1½" K.O. from the box.	. SC-2-19
24. Install the 1½" connector.	. SC-2-43
25. Cut the cable off long enough.	. SC-2-35
26. Strip the cable to length.	. SC-2-36
27. Braid the neutral conductor.	. SC-2-38
28. Cut the wires to length.	. SC-2-35
29. Strip the wire the same length as the lug.	. SC-2-36
30. Connect the service wires to the lugs.	. SC-2-45, IL-2-30
31. Seal the hole where the cable enters the house with air seal putty in the same way you sealed the weather connectors.	. SC-2-44
32. Install the ground clamp.	. IL-2-28
33. Connect the ground wire to the ground.	. SC-2-45, IL-2-25
34. Staple the ground wire.	. SC-2-18

METHOD OF EVALUATION:

The instructor will observe work in progress as well as finished job.

JOB: Install a 200 Ampere Service to the
Side of the House (Fuse Box)

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-57

COURSE: Electrical Occupations

MATERIAL: To be listed by the student

TOOLS: To be listed by the student

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. To be listed by the student.

METHOD OF EVALUATION:

- The instructor will check:
1. materials and tools listed.
 2. procedures.
 3. finished job.

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JOB: Install a 100 Ampere Trailer Service

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-58

COURSE: Electrical Occupations

MATERIAL: (14) Staples
Ground Clamp
1 1/4" Connector
4" Air Seal Putty
100 Amp Weatherhead
(9) 100 Amp Cable Straps
(4) 1 1/2" Flat Head Screws

14' #6 Bare Ground Wire
14' 100 Amp Aluminum Cable
100 Amp Trailer Fuse Box
24" x 30" x 3/4" Plywood Panel
(20) #12 x 1 1/4" Pan Head Screws
(2) 1 1/4" Weatherproof Connectors

EQUIPMENT: Hack Saw
2' Level
Chalkline

TOOLS: Claw Hammer
Pocket Knife

8" Screwdriver
10" Screwdriver

7" Side Cutters

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Strip 24" of 100 amp cable.	. SC-2-36
2. Braid the neutral conductor.	. SC-2-38
3. Install the weatherhead.	. SC-2-39
4. Mount the meter socket.	. SC-2-41, IL-2-30
5. Snap the chalkline where the cable is to be run.	. SC-2-37
6. Mount the weatherhead.	. SC-2-40, IL-2-25
7. Cut the cable off long enough to reach the lugs.	. SC-2-35
8. Install the weatherproof connector in the meter socket.	. SC-2-43
9. Strip the cable.	. SC-2-36
10. Strap the cable.	. SC-2-40
11. Braid the neutral conductor.	. SC-2-38
12. Attach the wire to the meter socket lugs.	. SC-2-45, IL-2-30
13. Strip the cable.	. SC-2-36

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
14. Install the weatherproof connector.	. SC-2-43, IL-2-25
15. Braid the neutral conductor.	. SC-2-38
16. Attach the wire to the lugs.	. SC-2-45, IL-2-30
17. Seal the weatherproof connectors.	. SC-2-44
18. Install the 1¼" weatherproof connector to the fuse box.	. SC-2-43
19. Cut the cable off long enough.	. SC-2-35
20. Strip the cable to length.	. SC-2-36
21. Braid the neutral conductor.	. SC-2-38
22. Cut the wires to length.	. SC-2-35
23. Strip the wire the same length as the lug.	. SC-2-36
24. Connect the service wires to the lugs.	. SC-2-45, IL-2-25
25. Install the ground clamp.	. IL-2-28
26. Connect the ground wire to the ground lug in the fuse box.	. SC-2-45, IL-2-25
27. Staple the ground wire.	. SC-2-18

METHOD OF EVALUATION:

The instructor will observe work in progress as well as finished job.

JOB: Install a Surface Mount Dryer
Outlet

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-59

COURSE: Electrical Occupations

MATERIAL: To be listed by the student

TOOLS: To be listed by the student

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Locate as per instructor specifications. 2. Install outlet.	. IL-2-37

METHOD OF EVALUATION:

The instructor will:

1. check students' lists.
2. observe work in progress.
3. inspect finished job.

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JOB: Install a Recessed Dryer Outlet

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: To be listed by the student

TOOLS: To be listed by the student

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-60

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Hook up.	. IL-2-47
2. See instructor for location.	

METHOD OF EVALUATION:

The instructor will:

1. check lists.
2. observe work in progress.
3. inspect finished job.

JOB: Install a Surface Mount Range
Outlet

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-61

COURSE: Electrical Occupations

MATERIAL: To be listed by the student

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up.	. IL-2-49
2. See instructor for location.	

METHOD OF EVALUATION:

The instructor will check:
1. students' list.
2. finished job.

JOB: Install a Recessed Range Outlet
UNIT II: Wiring Methods
COURSE: Electrical Occupations
MATERIAL: To be listed by the student

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-62

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Hook up.	. IL-2-49
2. See instructor for location.	

METHOD OF EVALUATION:

The instructor will inspect finished job and see that correct materials were used.

JOB: Install Two Flood Lights Controlled
by a Photo Cell Switch

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-63

COURSE: Electrical Occupations

DRAWING NO: D-2-63

MATERIAL: (6) Wire Nuts (6) Romex Connectors (2) 75 Watt Flood Lights
25' 12-2 WG (2) 4" Round Boxes (2) Outdoor Bullet Type
(4) Jiffy Holders 600 Watt Photo Cell Fixtures

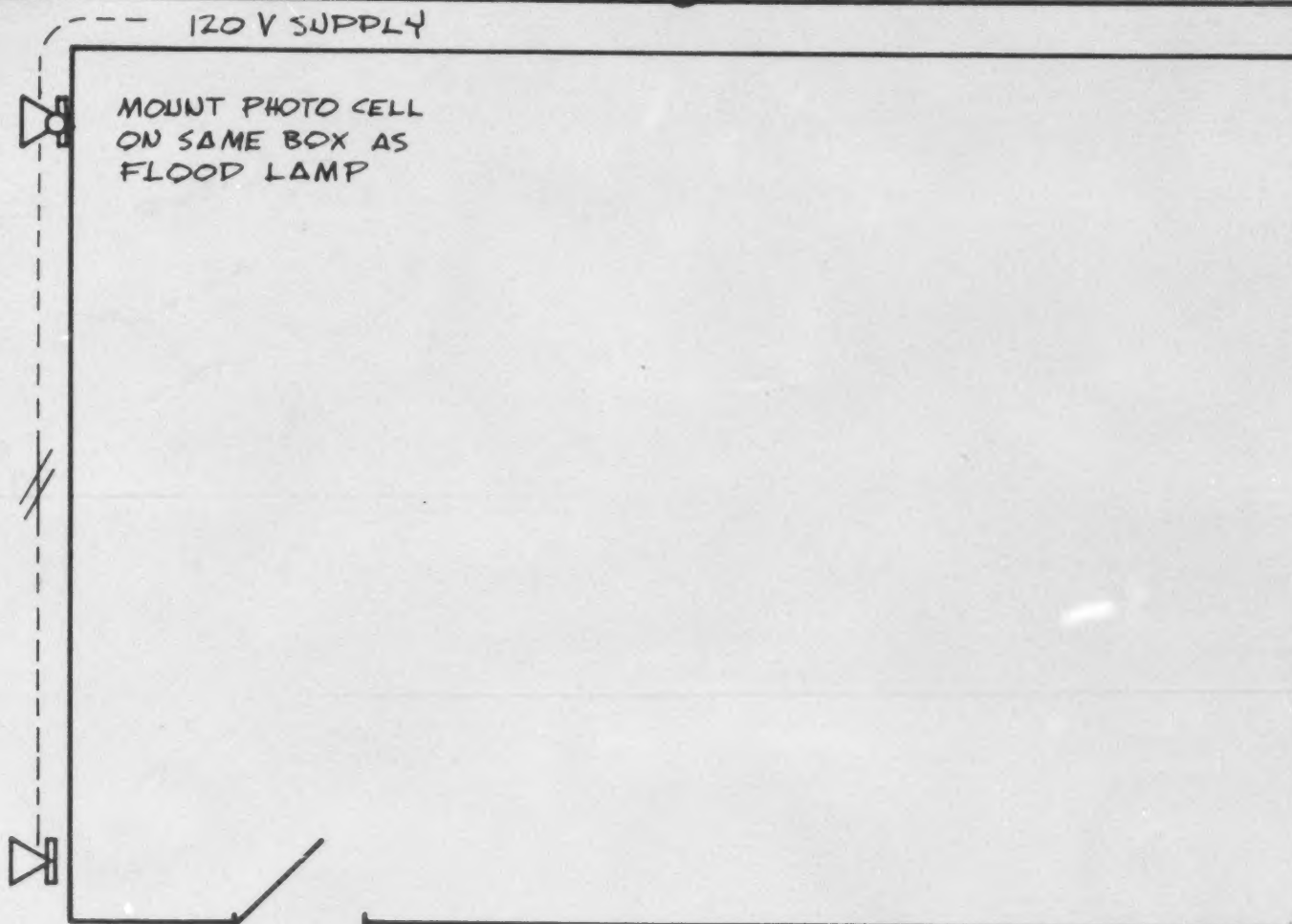
EQUIPMENT: To be listed by the student

TOOLS: To be listed by the student

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up the photo cell according to the manufacturer's specifications.	
2. See instructor for location.	

METHOD OF EVALUATION:

The instructor will check equipment and tools used, and inspect finished
job.



SCALE:

APPROVED BY:

DRAWN BY

DATE:

REVISED

TWO FLOOD LIGHTS CONTROLLED BY A PHOTO CELL SWITCH

DRAWING NUMBER

D-2-63

JOB: Install Baseboard Heat and Hook Up
Power

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-64

COURSE: Electrical Occupations

DRAWING NO: D-2-64

MATERIAL: To be listed by the student

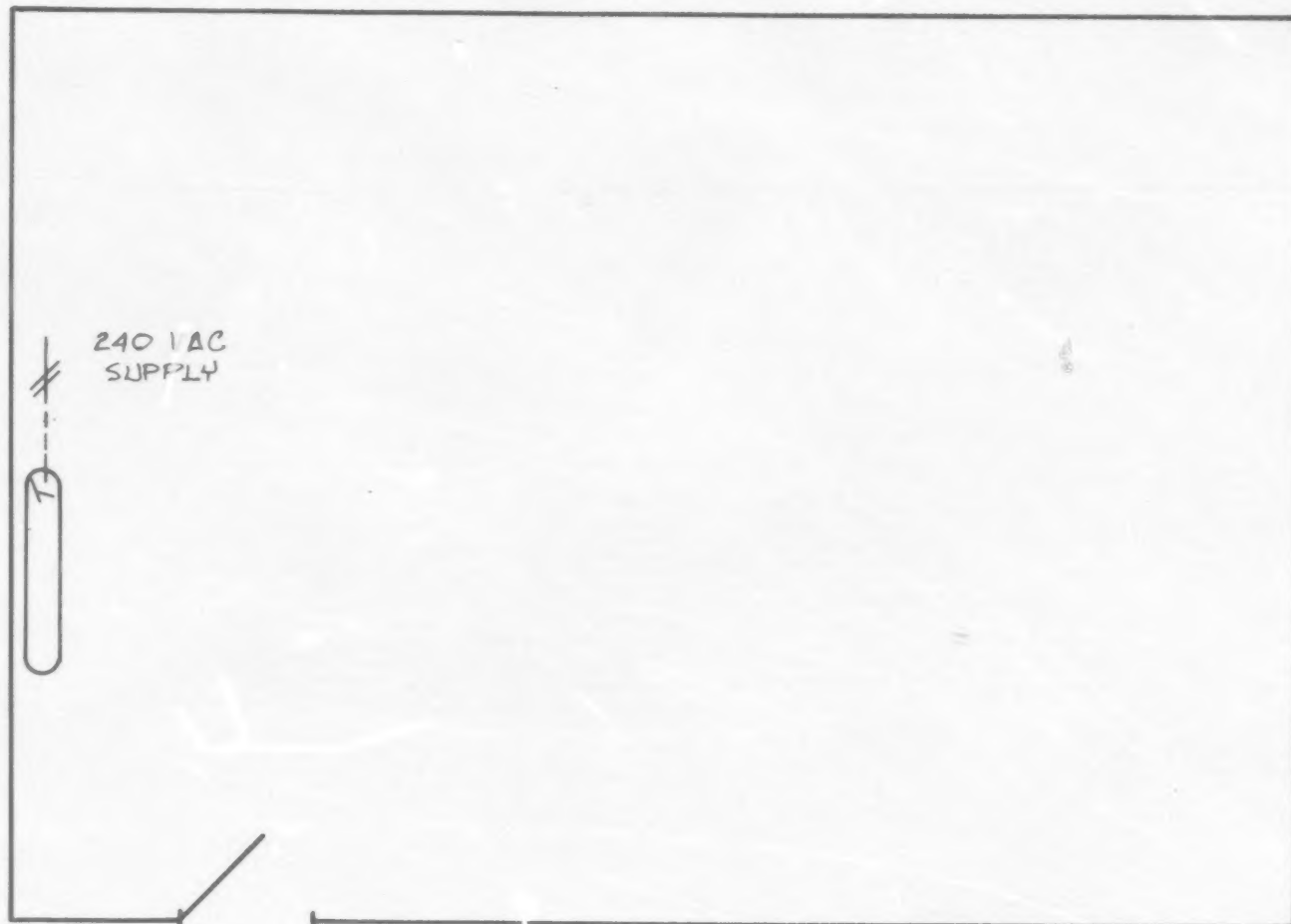
TOOLS: To be listed by the student

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Mount the heat.	. IL-2-48
2. Hook up the power.	. IL-2-45, IL-2-46

METHOD OF EVALUATION:

The instructor will check the material and tools used as well as inspect the finished job.

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SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
BASEBOARD HEAT		
		DRAWING NUMBER
		D-2-64

JOB: Install Baseboard Heat and Mount
the Thermostat on the Wall

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-65

COURSE: Electrical Occupations

DRAWING NO: D-2-65

MATERIAL: To be listed by the student

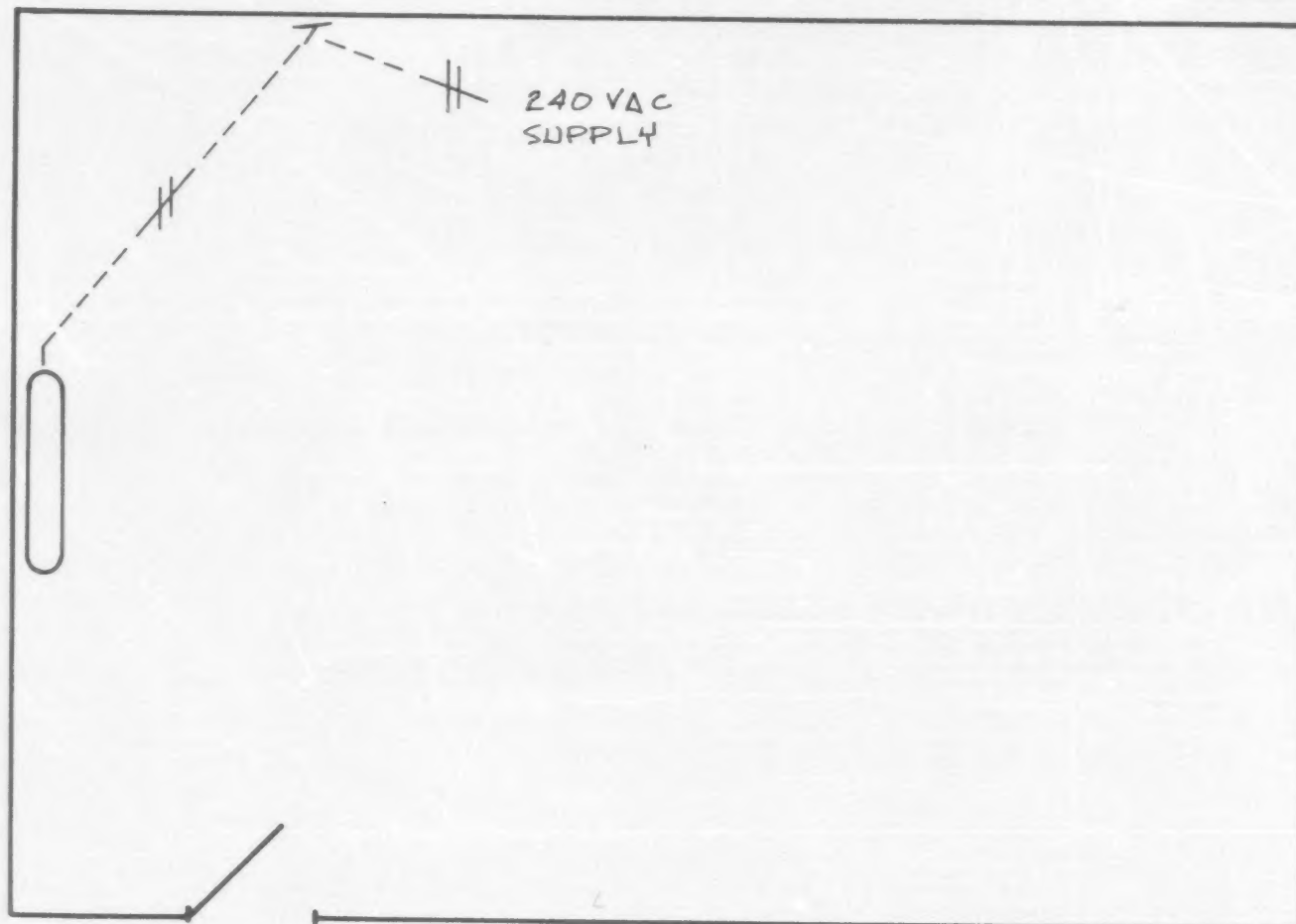
EQUIPMENT: By this time the student should know what is to be listed

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install and hook up the heat.	. IL-2-48
2. See instructor for location.	

METHOD OF EVALUATION:

The instructor will check finished job.

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SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
BASEBOARD HEAT WITH THERMOSTAT MOUNTED ON THE WALL		
		DRAWING NUMBER
		D-2-65

JOB: Install Electric Heat in Two Rooms
on the Same Circuit

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-66

COURSE: Electrical Occupations

DRAWING NO: D-2-66

MATERIAL: To be listed by the student

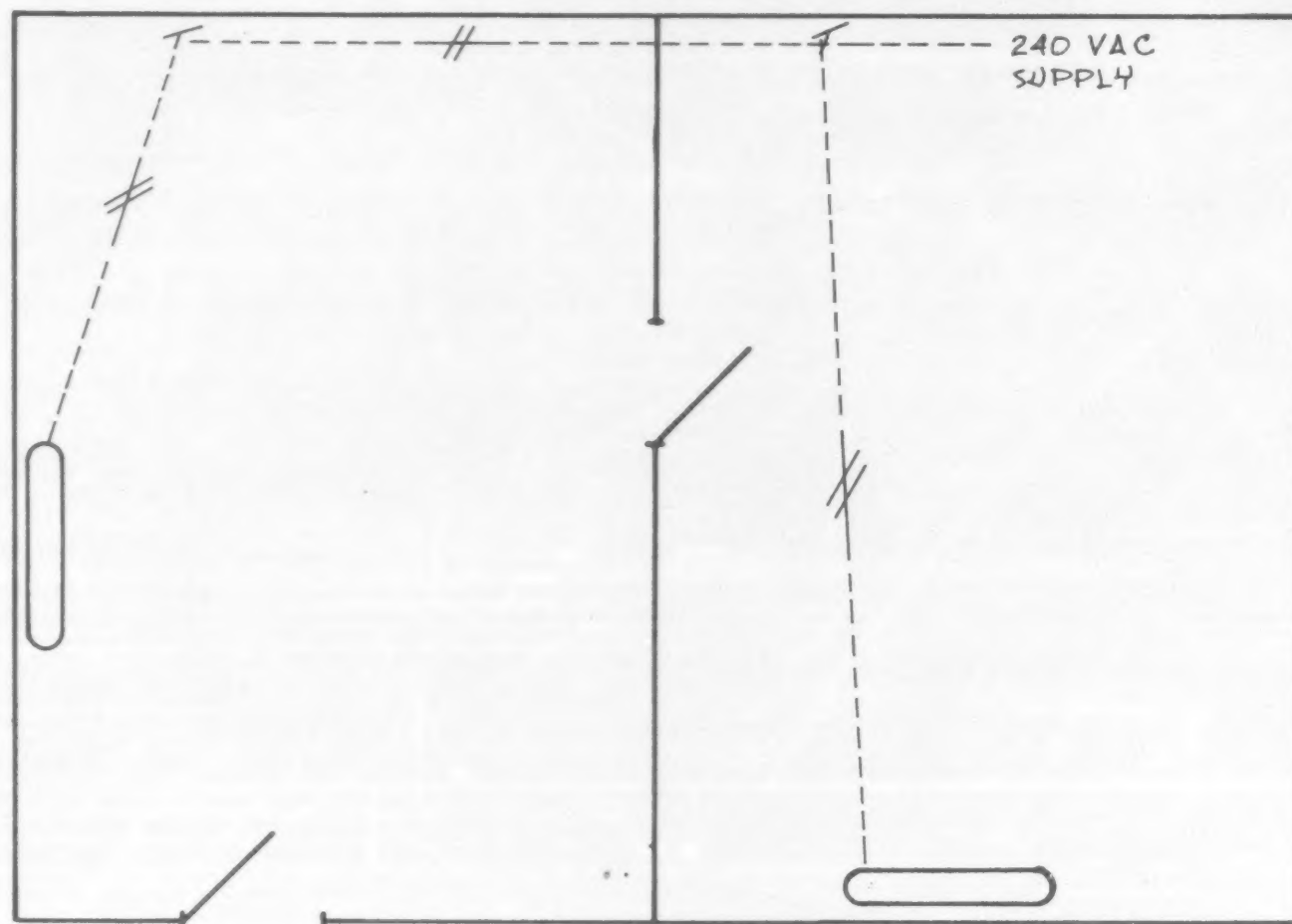
EQUIPMENT: 24" Level
1/4" Drill Motor
1/2" Drill Bit

TOOLS: Hammer
Wire Strippers
7" Side Cutters
6" Screwdriver
Romex Strippers
6' Wooden Rule
12' Steel Tape Rule
Knife

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install and hook up the heat.	. IL-2-48
2. See instructor for location.	

METHOD OF EVALUATION:

The instructor will check the finished system.



SCALE:

APPROVED BY:

DRAWN BY

DATE:

REVISED

ELECTRIC HEAT IN TWO ROOMS ON THE SAME CIRCUIT

DRAWING NUMBER

D-2-66 134

JOB: Install Two Sections of Electric
Heat Butted Together; with a
Thermostat Mounted on the Wall

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-67

COURSE: Electrical Occupations

DRAWING NO: D-2-67

MATERIAL: To be listed by the student

EQUIPMENT: 24" Level
1/4" Drill Motor

1/2" Drill Bit
Splice Cap Crimpers

TOOLS: Hammer
Knife
Wire Strippers
Romex Strippers

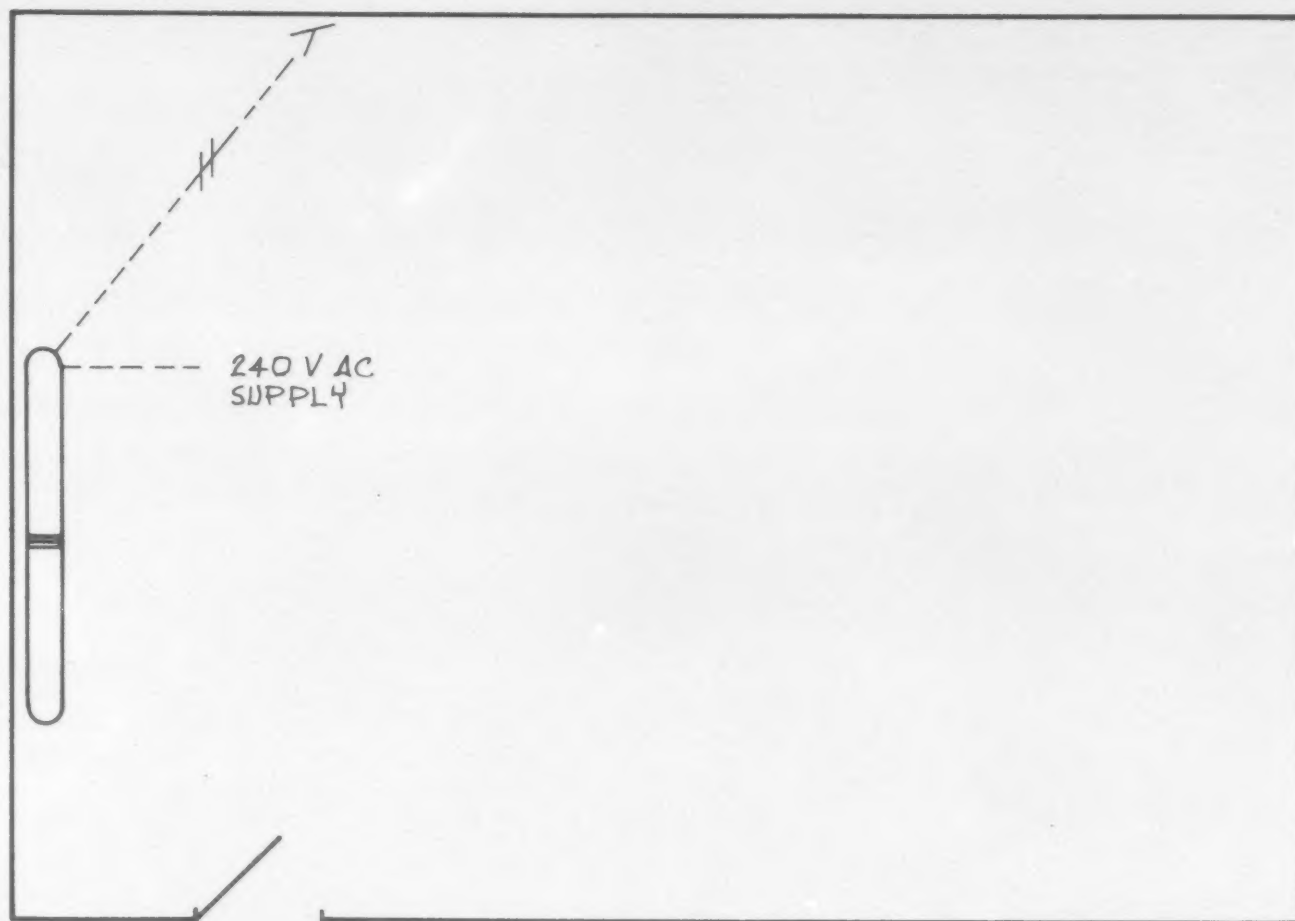
7" Side Cutters
6" Screwdriver
6' Wooden Rule
12' Steel Tape Rule

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install and hook up the heat.	. IL-2-48
2. See instructor for location.	

METHOD OF EVALUATION:

The instructor will check to see that the correct material was used.

231



SCALE:		APPROVED BY:	DRAWN BY
DATE:			REVISED
TWO SECTIONS OF ELECTRIC HEAT BUTTED TOGETHER WITH WALL MOUNTED THERMOSTAT			
DRAWING NUMBER			0-2-67

JOB: Install a Bathroom Heater and Hook
Up the Power

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-68

COURSE: Electrical Occupations

MATERIAL: To be listed by the student

EQUIPMENT: $\frac{1}{4}$ " Drill Motor
 $\frac{1}{2}$ " Drill Bit

TOOLS: Hammer
Knife
6' Wooden Rule
6" Screwdriver
7" Side Cutters
Wire Strippers
Romex Strippers

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	
1. To be listed by the student.	. IL-2-48

METHOD OF EVALUATION:

The instructor will check the procedure the student used to finish the job.

JOB: Install 5 Receptacles on the same
Circuit Using Conduit

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-69

COURSE: Electrical Occupations

DRAWING NO: D-2-69

MATERIAL: (24) Plastic Anchors
(5) Utility Boxes
(5) Duplex Receptacles
(5) Utility Box Covers
(2) $\frac{1}{2}$ " Red 90°'s
(4) $\frac{1}{2}$ " Set Screw T's W/C

(6) $\frac{1}{2}$ " EMT Connectors
(14) $\frac{1}{2}$ " EMT Straps
60' $\frac{1}{2}$ " EMT Conduit
112' #12 TW Black
112' #12 TW White
(5) Ground Screws

EQUIPMENT: $\frac{1}{4}$ " Drill Motor
 $\frac{1}{4}$ " Masonry Drill Bit

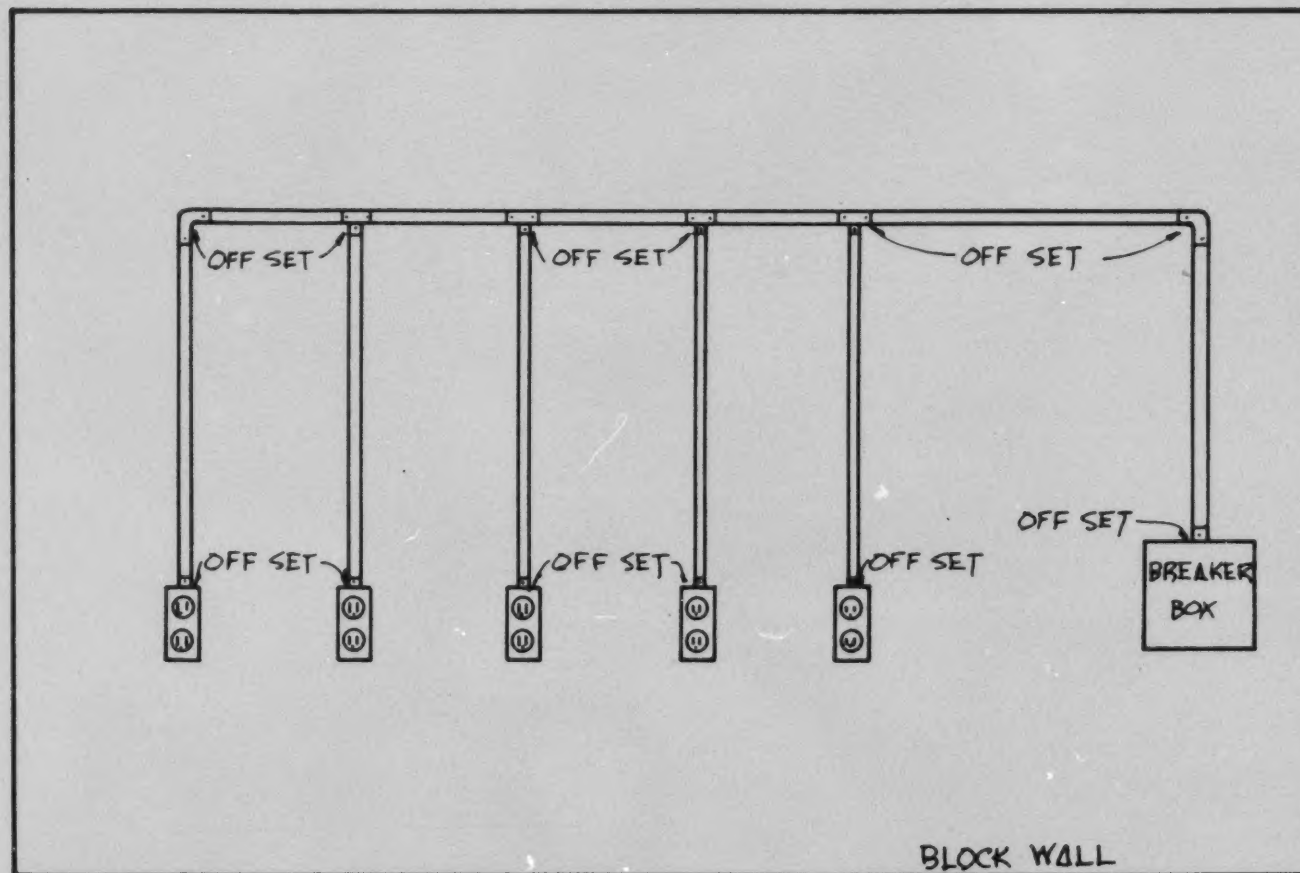
25' Extension Cord
 $\frac{1}{2}$ " Hickey

TOOLS: 6" Screwdriver
7" Side Cutters

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount the boxes.	. SC-2-42
2. Install the conduits.	. SC-2-46 through SC-2-52
3. Install the connectors.	. SC-2-49
4. Push the fish tape in the conduit.	
5. Attach the wires to the fish tape.	. SC-2-7
6. Pull the wire in the conduit.	
7. Make all connections.	. SC-2-7, IL-2-4
8. Install the outlets.	. SC-2-23

METHOD OF EVALUATION:

The instructor will inspect the finished job.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
FIVE RECEPTACLES ON THE SAME CIRCUIT		
		DRAWING NUMBER D-2-69 191

JOB: Install 2 Three-way Switches
Controlling One Light with $\frac{1}{2}$ "
Conduit

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-70

COURSE: Electrical Occupations

DRAWING NO: D-2-70

MATERIAL: (6) $\frac{1}{2}$ " Connectors
4" Octagon Box
17' $\frac{1}{2}$ " Conduit
(2) Utility Boxes
Fuse Box
6' #14 TW Solid Red
21' #14 TW Solid Black

Spotlight Fixture and Light
(2) 3-way Switches
(2) Switch Covers
(3) 10/32 Ground Screws
(2) Ground Splice Caps
21' #14 TW Solid Green
21' #14 TW Solid White

EQUIPMENT: $\frac{1}{4}$ " Drill Motor
 $\frac{1}{4}$ " Masonry Drill Bit

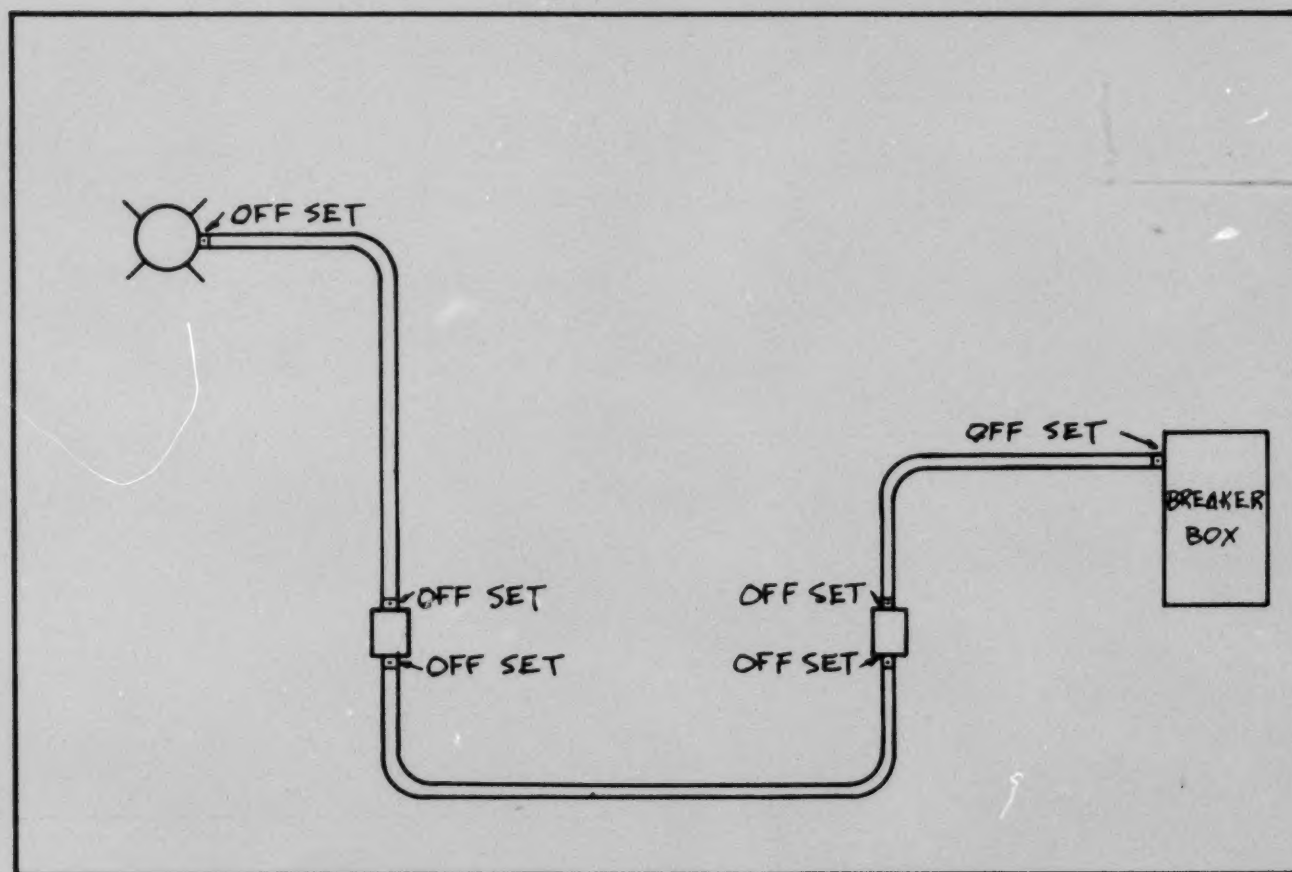
Fish Tape
25' Extension Cord

TOOLS: 6" Screwdriver
7" Side Cutters

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount all the boxes.	. SC-2-42
2. Fit the conduit.	. SC-2-46 through SC-2-48 . SC-2-51 through SC-2-53
3. Push the fish tape in.	
4. Attach the wires to the fish tape.	. SC-2-7
5. Pull the wires into the conduit.	. SC-2-17, IL-2-14
6. Make all the connections.	. SC-2-23, IL-2-14

METHOD OF EVALUATION:

The finished work will be checked by the instructor.



SCALE:		APPROVED BY:	DRAWN BY
DATE:			REVISED
TWO THREE-WAY SWITCHES CONTROLLING ONE LIGHT			
DRAWING NUMBER			D-2-70

JOB: Install Two Flood Lights
Controlled by a Time Switch

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-71

COURSE: Electrical Occupations

DRAWING NO: D-2-71

MATERIAL: (4) $\frac{1}{2}$ " Connectors
(2) 4" Square Boxes
10' $\frac{1}{2}$ " Conduit
Clock Timer
(4) Wire Nuts
Ground Splice Cap

(2) Spot light and Fixtures
(2) 10/32 Ground Wires
11' #12 TW White
11' #12 TW Black
(2) $\frac{1}{2}$ " Conduit Straps
(12) Plastic Anchors and Screws

EQUIPMENT: $\frac{1}{4}$ " Drill Motor
 $\frac{1}{4}$ " Masonry Drill Bit
25' Extension Cord

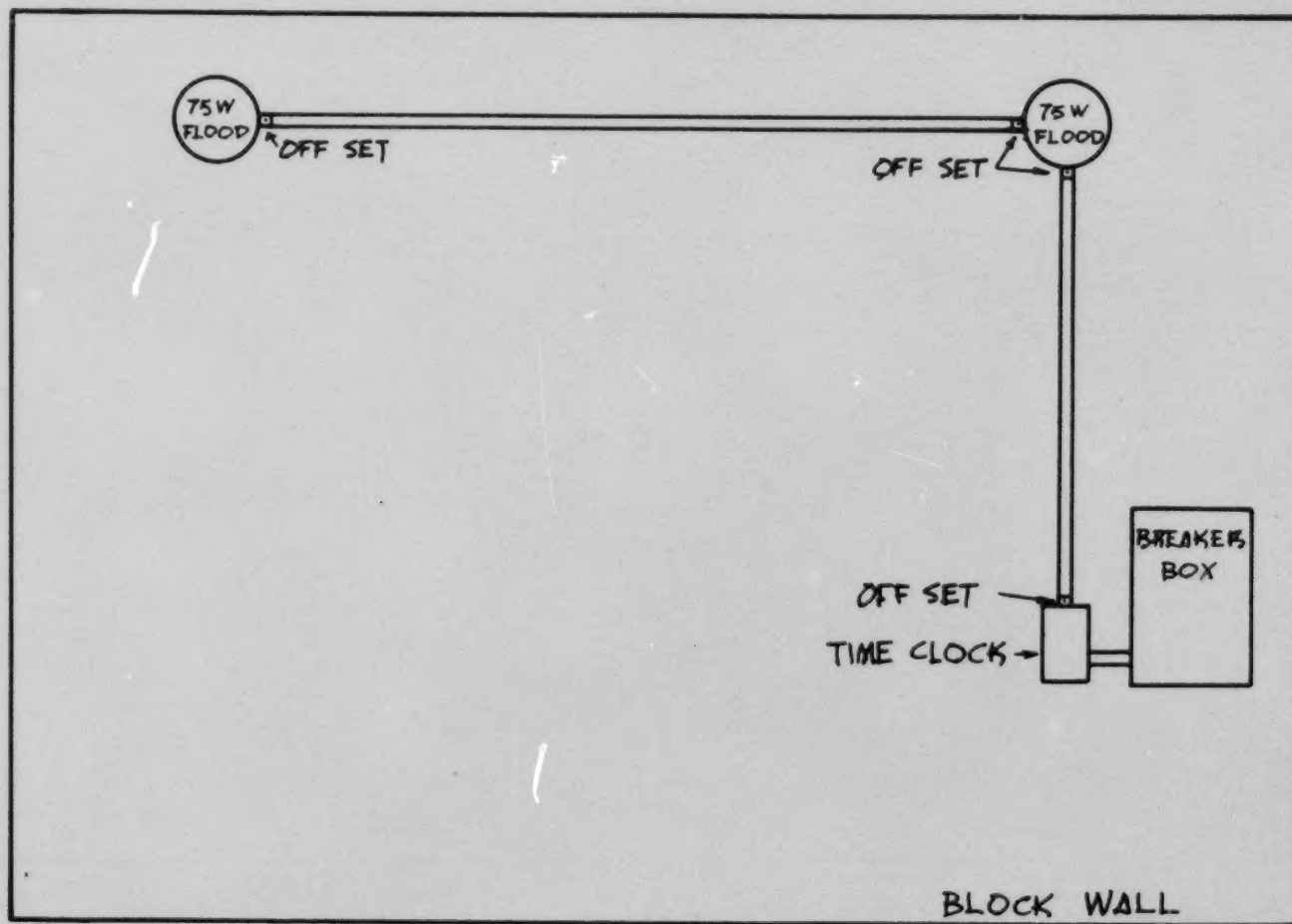
$\frac{1}{2}$ " Hickey
Fish Tape

TOOLS: 6" Screwdriver
7" Side Cutters

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount the time clock.	. SC-2-42
2. Mount the light boxes.	. SC-2-42
3. Fit the conduit.	. SC-2-46 through SC-2-48 . SC-2-41 through SC-2-53
4. Push the fish tape in.	
5. Attach the wires to the fish tape.	. SC-2-7
6. Pull the wire into the conduit.	. SC-2-17
7. Hook up according to the manufacturer's specifications (on the time clock door).	. SC-2-23

METHOD OF EVALUATION:

The instructor will check quality of finished job.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
TWO FLOOD LIGHTS CONTROLLED BY A TIME SWITCH		
		DRAWING NUMBER
		D-2-71

JOB: Install a Door Bell Controlled
from One Point

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-72

COURSE: Electrical Occupations

DRAWING NO: D-2-72

MATERIAL: (12) Romex Staples
(14) Insulated Saddle Staples
(2) #12 x 3/4 Pan Head Screws
15' 18/2 Bell Wire
1/2" Romex Connector
Bell Transformer

Door Bell
Push Button
15' 14-2 W/G
4" Round Box
4" Round Box Cover

EQUIPMENT: 1/4" Drill Motor
3/8" Wood Bit

1/2" Wood Bit
25' Extension Cord

TOOLS: 7" Side Cutters
Pocket Knife
8" Screwdriver

Claw Hammer
6' Wooden Rule

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

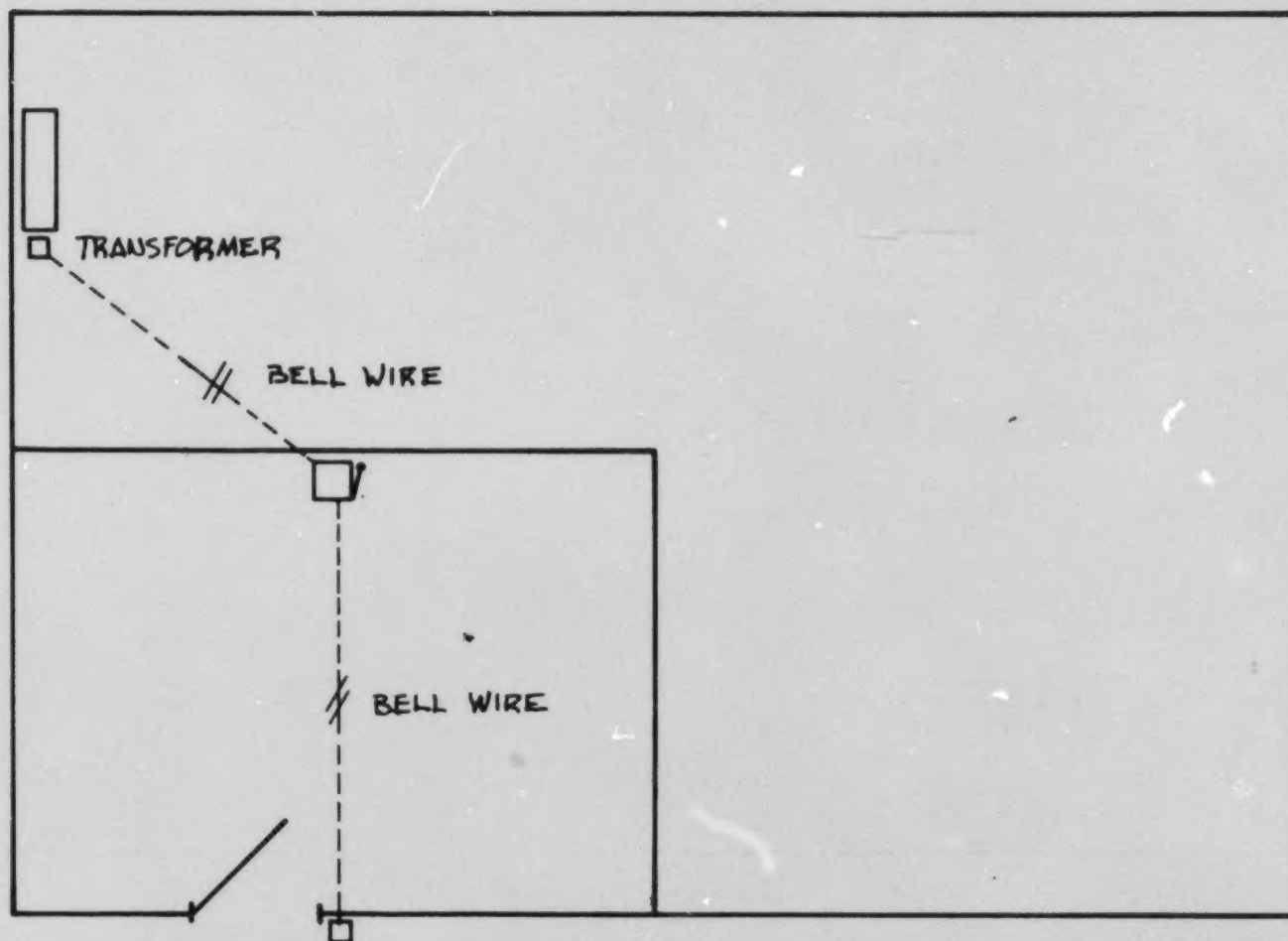
TEACHING/LEARNING ACTIVITIES

1. Install the door bell according to the
manufacturer's specifications.

. IL-2-52

METHOD OF EVALUATION:

The instructor will check the finished job.



SCALE:	APPROVED BY:	DRAWN BY
RATE:		REVISED
DOOR BELL CONTROLLED FROM ONE POINT		
		DRAWING NUMBER
		D-2-72

JOB: Install a Door Bell Controlled
from Two Points

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-73

COURSE: Electrical Occupations

DRAWING NO: D-2-73

MATERIAL: (2) Push Buttons
15' 14-2 W/G
Bell Transformer
½" Romex Connector
(12) Romex Staples
25' 18/2 Bell Wire

25' 18/3 Bell Wire
Door Bell Combination
for Front and Back Door
4" Round Box and Cover
(2) #12 x 3/4 Pan Head Screws
(30) Insulated Saddle Staples

EQUIPMENT: ¼" Drill Motor
3/8" Wood Bit

½" Wood Bit
25' Extension Cord

TOOLS: Claw Hammer
Pocket Knife
7" Side Cutters

6' Wooden Rule
8" Screwdriver

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

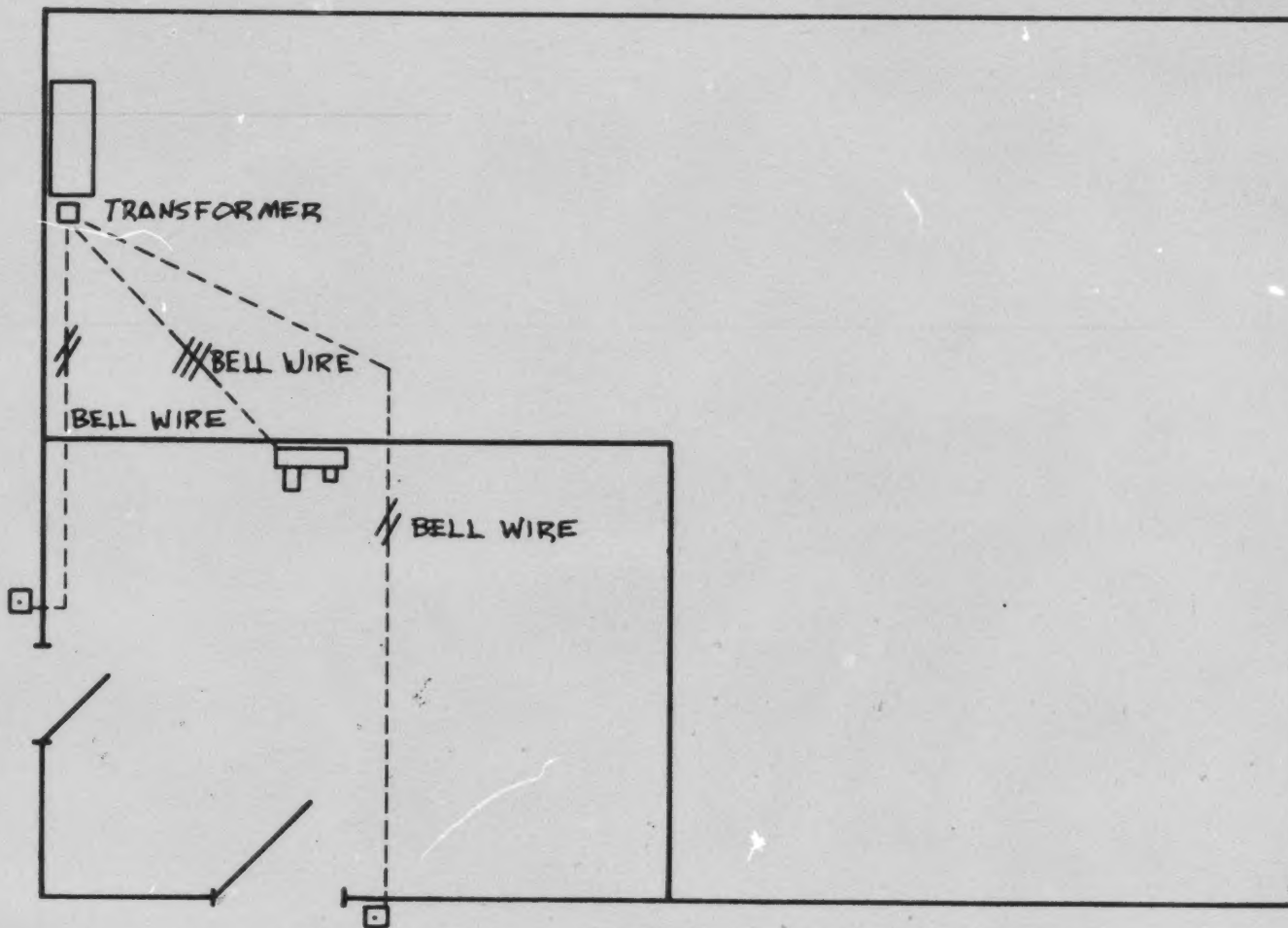
TEACHING/LEARNING ACTIVITIES

1. Install the door bells according to the
manufacturer's specifications.

. IL-2-52

METHOD OF EVALUATION:

The finished job will be checked by the instructor.



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202

SCALE:		APPROVED BY:	DRAWN BY
DATE:			REVISED
DOOR BELL CONTROLLED FROM TWO POINTS			
DRAWING NUMBER			203

D-2-73

203

JOB: Install a Door Bell Controlled
from Three Points

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-74

COURSE: Electrical Occupations

DRAWING NO: D-2-74

MATERIAL: (3) Push Buttons
(15) Romex Staples
15' 14-2 W/G
Bell Transformer
 $\frac{1}{2}$ " Romex Connector
30' 18/2 Bell Wire

Door Bell Combination for
Front, Back and Side Door
(60) Insulated Saddle Staples
4" Round Box and Cover
(2) #12 x 3/4 Pan Head Screws
30' 18/4 Bell Wire

EQUIPMENT: $\frac{1}{4}$ " Drill Motor
3/8" Wood Bit

$\frac{1}{2}$ " Wood Bit
25' Extension Cord

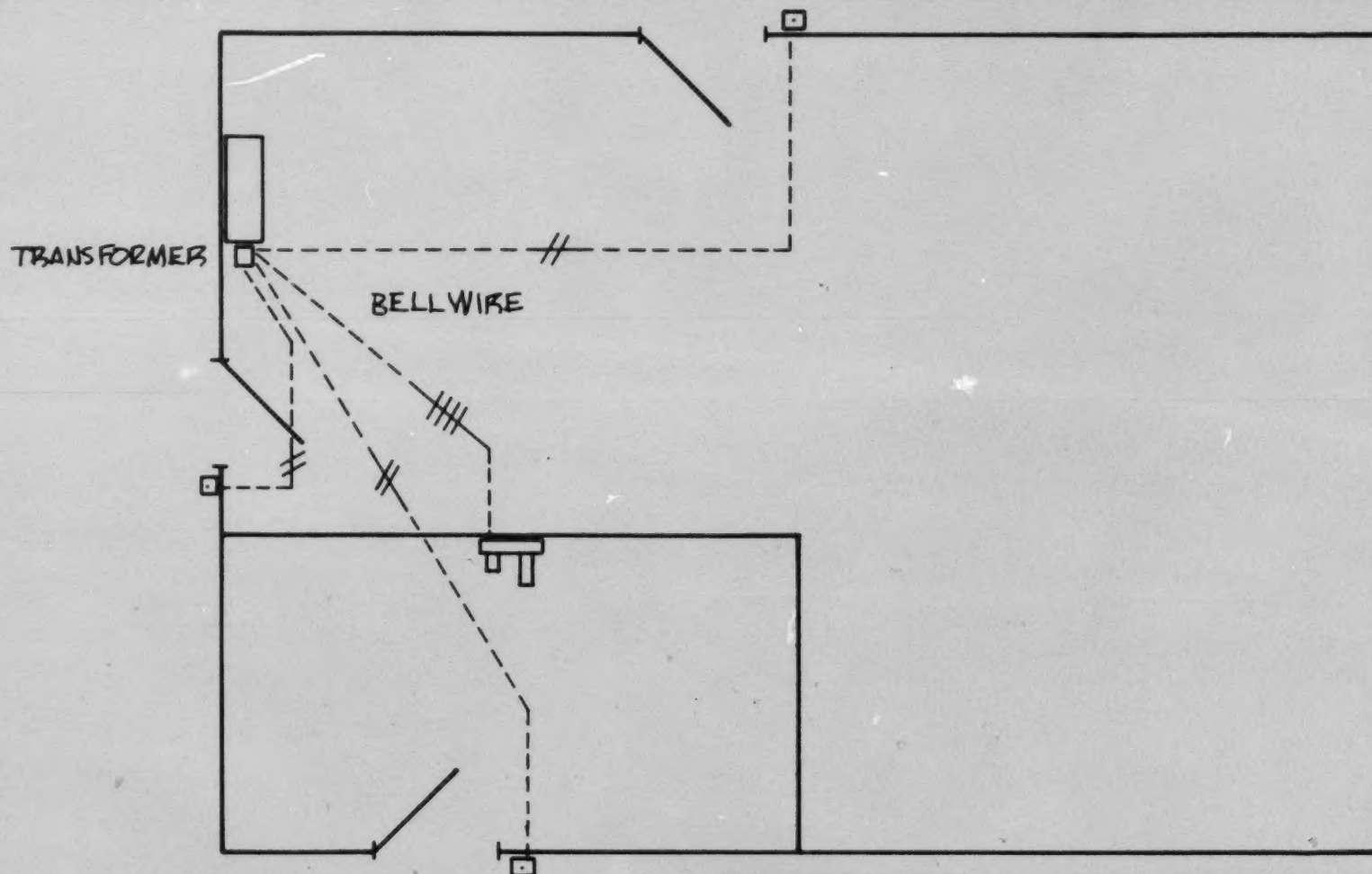
TOOLS: 7" Side Cutters
Pocket Knife
8" Screwdriver

Claw Hammer
6' Wooden Rule

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	
1. Install the door bells according to the manufacturer's specifications.	. IL-2-52

METHOD OF EVALUATION:

The instructor will inspect the finished job.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
DOOR BELL CONTROLLED FROM THREE POINTS		
		DRAWING NUMBER D-2-74 206

JOB: Install a Manual Annunciator

JOB SHEET
IDENTIFICATION CODE

UNIT II: Wiring Methods

JOB NUMBER: J-2-75

COURSE: Electrical Occupations

MATERIAL: Manual Annunciator System Staples
Push Button Control Station 120/24 V. Transformer

EQUIPMENT: $\frac{1}{4}$ " Drill Motor
25' Extension Cord

TOOLS: Standard Electricians' Tool Pouch
 $\frac{1}{4}$ " Wood Bit - Flat Boring

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Layout and mount system.	SEE: Annunciator manufacturer's specifications
2. Wire up system.	
3. Check out system.	

METHOD OF EVALUATION:

The instructor will check out system.

JOB: Install an Automatic Annunciator

UNIT II: Wiring Methods

COURSE: Electrical Occupations

MATERIAL: Automatic Annunciator System
Push Button Control Station
120/24V Transformer

EQUIPMENT: $\frac{1}{4}$ " Drill Motor
25' Extension Cord

TOOLS: Standard Electricians' Tool Pouch
 $\frac{1}{4}$ " Wood Bit - Flat Boring

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-76

#18 Wire
#18 Wire
Staples

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Layout and mount system.	SEE: Annurciator manufacturer's specifications.
2. Wire up system.	
3. Check out system.	

METHOD OF EVALUATION:

The system will be checked by the instructor.

JOB: Connect and Operate a Seperate
Excited D.C. Shunt Generator

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-1

COURSE: Electrical Occupations

DRAWING NO: D-3-1

MATERIAL: 2 Eschtcheon Plates
8 Patch cords

EQUIPMENT: Base Unit DC Voltmeter
DC Generator DC Ammeter
AC Motor 2 DPDT Switch Field Rheostat

TOOLS: Standard Electricians Tool Pouch

SAFETY PRECAUTIONS:

Observe caution in handling voltages, currents and rotating shafts

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Set up job, secure and wire as in D-3-1.

NOTE: The DC Generator is connected to operate as a seperately excited shunt generator.

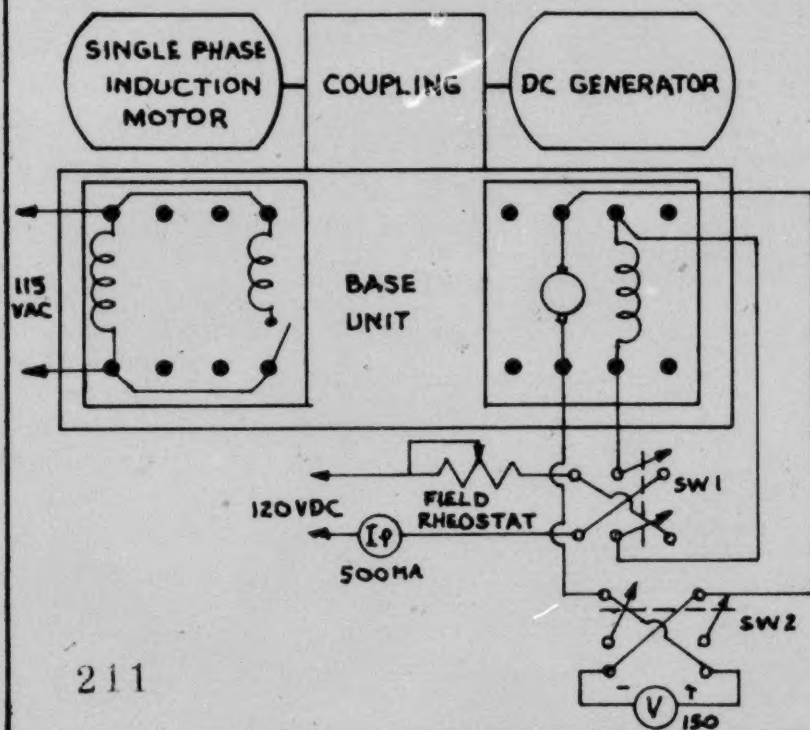
2. With all switches open turn on AC power to drive DC generator.
3. Close switch SW1 in position 1. This will give a direction of current through the field winding from F1 to F2. Momentarily check if voltmeter is reading correctly. If so, close completely. If not, close switch SW1 in other direction. Record the polarity of the armature in table 1. Open switch SW1.

NOTE: Generator should rotate clock-wise. To change direction reverse the starting windings of the motor.

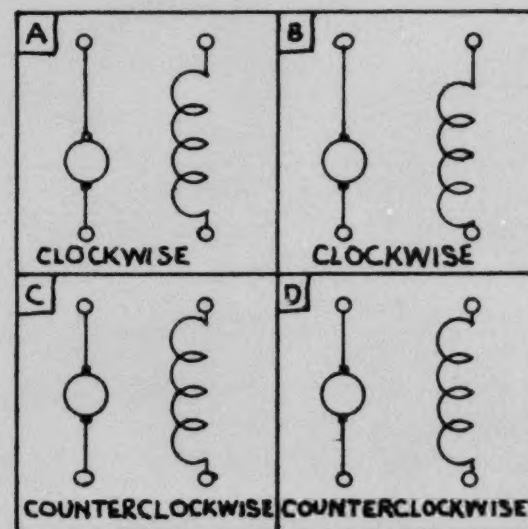
COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
4. Adjust the field rheostat from minimum resistive to maximum resistive and record maximum and minimum generator output voltage obtained. 5. Close switch SW1 in position #2. Repeat step #3. Record results on table 1B. 6. Turn off all power and reverse direction of AC motor by procedure step 2. 7. Repeat procedure step #3. Record results in table 1C. 8. Repeat procedure step #5. Record results in table 1D. 9. Turn off power, AC and DC power to the field winding. 10. Dismantle.	7

METHOD OF EVALUATION:

Check the values at tables.



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SEPERATE EXCITED D.C. SHUNT GENERATOR

212

D-3-1

JOB: Wire and Load a Separate Excited
D.C. Shunt Generator

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-2

COURSE: Electrical Occupations

DRAWING NO: D-3-2

MATERIAL: 2 Escutcheon Plates
8 Patch Cords

EQUIPMENT:	Base Unit	Field Rheostat	DC Ammeter
	Resistive Load Unit	DC Voltmeter	0-500ma
	DC Generator	0-150V	DC Ammeter
	Single-phase Motor	#6 Volt. Battery	0-1.5A

TOOLS: Standard Electricians Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-2.	NOTE: Generator connected as a separately excited shunt generator.
2. Turn AC Motor.	NOTE: Speed kept constant throughout the test.
3. Adjust Field Rheostat and Resistive Load at rated load current to obtain rated output voltage.	
4. Load generator through 8 steps 0 to 125% of its rated-load current. Record in Table 1 load current I_L , terminal voltage V and field current I_f .	
5. Decrease the load to zero, turn off powers, AC and DC.	
6. With generator still hot, measure the armature resistance by the voltmeter-ammeter method; connect as in Figure 2. Record the voltage and current in table 2.	
7. Calculate the armature resistance R_A and record in table 2.	

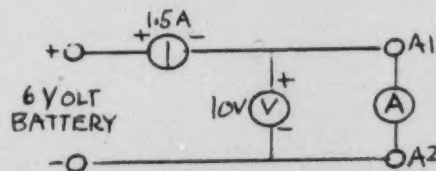


FIG. 2.

METHOD OF EVALUATION:

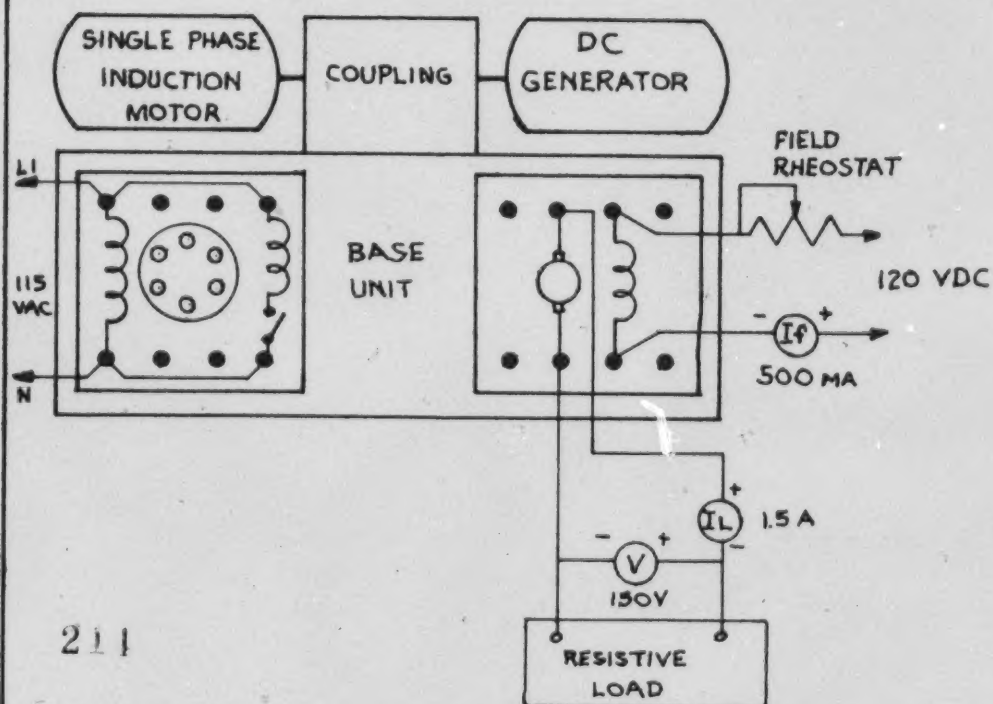
Check on the tables to see if values are corrected. Give assignment No. .

TABLE 1

IL AMP	V VOLTS	If MA	IA AMPS	IA RA VOLTS

TABLE 2

CURRENT	
VOLTAGE	
RA	



SEPARATE EXCITED D.C. SHUNT GENERATOR		
215		D-3-2

JOB: Connect and Operate a Self-
Excited D.C. Shunt Generator

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-3

COURSE: Electrical Occupations

DRAWING NO: D-3-3

MATERIAL: 2 Escutcheon Plates
8 Patch Cords

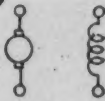
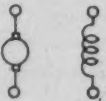
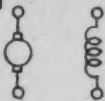
EQUIPMENT: Base Unit DC Voltmeter
DC Generator 0-150V
AC Single-phase Motor DC Ammeter
Field Rheostat 0-500ma 2 DPDT Switch Units

TOOLS: Standard Electricians Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-3.	NOTE: Generator connected to operate as a self excited shunt.
2. With switch SW1 open, flash the field with 120VDC for 30 seconds. Positive terminal at F1, negative terminal at F2. Remove DC power.	NOTE: This will set the direction of the residual magnetism.
3. With switch SW1 open, turn on the AC motor.	NOTE: Generator should rotate clockwise.
4. Record the polarity of the armature terminals in table 1A.	NOTE: This will be a low voltage.
5. With maximum field resistance in the field winding, close switch SW1 in position 1. Gradually reduce the field resistance and note the change in terminal voltage. Turn the field resistance back to maximum, reverse SW1 and repeat this step. Record the polarity of the armature terminals and the actual connections to achieve voltage buildup in table 1B.	NOTE: Only one position of switch SW1 will give a build-up in the terminal voltage.
6. Turn power to AC motor. Reverse the motor's direction.	NOTE: To change direction reverse the starting windings of motor.
7. With switch SW1 open turn the motor.	NOTE: Generator should rotate counter clockwise.

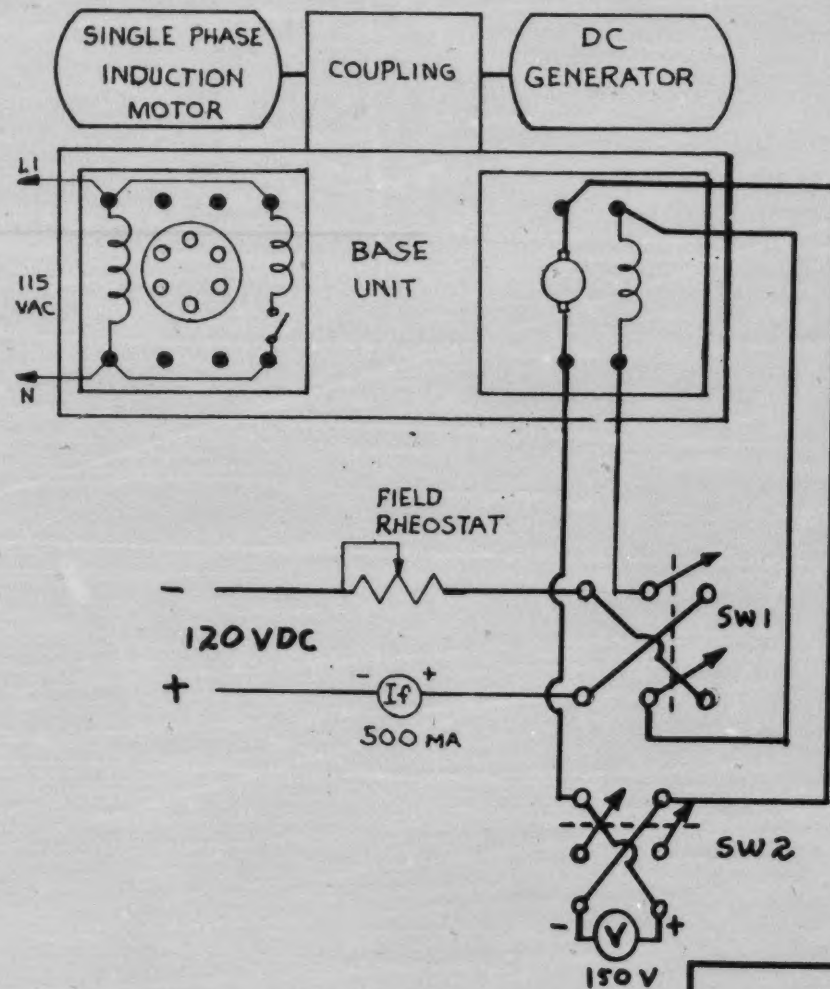
8. Repeat step #5. Record the polarity of the armature and the actual connections in table 1D.
9. Turn the power off.
10. Disconnect all equipment.

TABLE 1

A 	B 
C 	D 

METHOD OF EVALUATION:

Check on table values and DWG.



SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
SELF EXCITED D.C. SHUNT GENERATOR		
DRAWING NUMBER		
D-3-3		219

JOB: Wire and Load a Self Excited
D.C. Shunt Generator

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-4

COURSE: Electrical Occupations

DRAWING NO: D-3-4

MATERIAL: 2 Escutcheon Plates
8 Patch Cords

EQUIPMENT: Base Unit
DC Generator
AC Single-phase Motor
Resistive Load

DC Voltmeter
0-150V
DC Ammeter
0-1.5A

DC Ammeter
0-500ma
#6 Volt Battery
Field Rheostat

TOOLS: Standard Electricians Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-4.	NOTE: Generator to operate as a self excited shunt generator.
2. Make 2 tables similar to tables 1 and 2.	
3. Turn on AC motor.	NOTE: Speed kept constant.
4. Adjust the field rheostat and resistive load current to obtain rated output voltage.	
5. Load generator through 8 steps from 0 to 125% of its rated-load current. Record in table 1, the load current I_L , the terminal voltage V and the field current for each step.	
6. Decrease the load to zero. Turn off power.	
7. With the generator still hot measure the armature resistance by the voltmeter-ammeter method as in figure 2.	

METHOD OF EVALUATION:

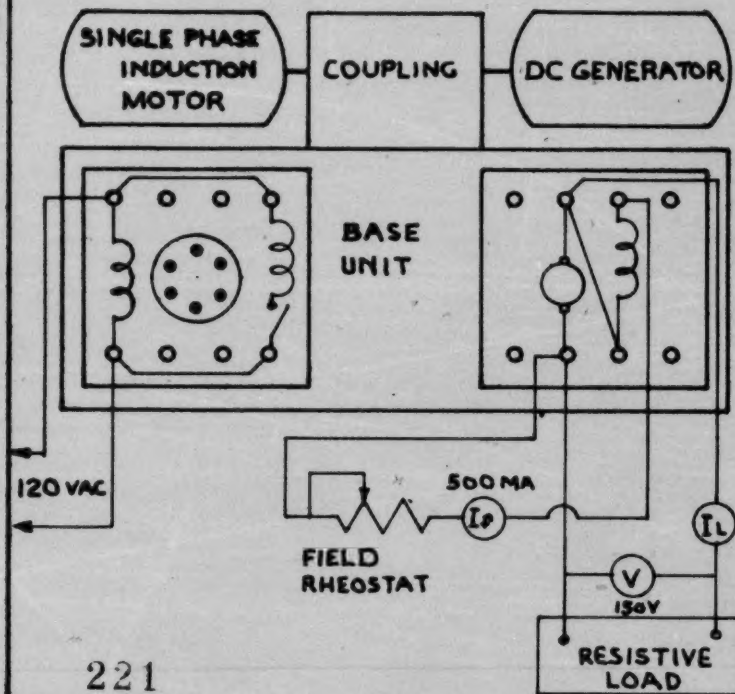
1. Check the tables to see if they are corrected.
2. Have the students give their conclusions about a self excited D.C. shunt generator.

TABLE 1

I_L AMP	V VOLT	I_f MA	I_A AMP	$I_A R_A$ VOLT

TABLE 2

CURRENT	
VOLTAGE	
R_A	



SELF EXCITED D.C. SHUNT GENERATOR

222

D-3-4

JOB: Wire and Load a D.C. Series Generator

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-5

COURSE: Electrical Occupations

DRAWING NO: D-3-5

MATERIAL: 2 Escutcheon Plates
8 Patch Cords

EQUIPMENT: Base Unit Resistive Load Unit
DC Generator DC Voltmeter 0-150V
AC Motor DC Ammeter 0-1.5A

TOOLS: Standard Electricians Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-5.	NOTE: Generator connected to operate as a series generator.
2. Turn an AC motor.	NOTE: Speed kept constant throughout the test.
3. Load the generator through 8 steps from 0 to 20% of its rated-load current. Record in table 1 the load current I_L , terminal voltage V for each step.	
4. Decrease the load to zero.	
5. Turn off power to motor.	
6. Dismantle job.	

METHOD OF EVALUATION:

1. Check the values on tables.
2. Have the students give their conclusions of a series generator.

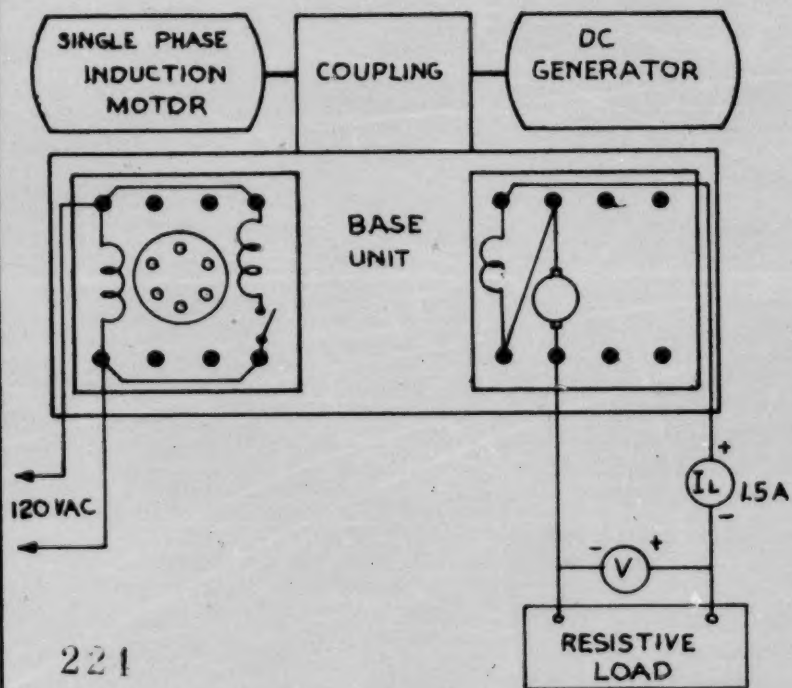


TABLE I

I_L AMP	V VOLTS

D.C. SERIES GENERATOR

225

D-3-5

JOB: Wire and Load a D.C. Compound Generator

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-6

COURSE: Electrical Occupations

DRAWING NO: D-3-6

MATERIAL: 2 Escutcheon Plates
8 Patch Cords

EQUIPMENT: Base Unit Field Rheostat
 DC Generator DC Voltmeter 0-150V
 AC Motor DC Ammeter 0-1.5A
 Resistive Load Unit DC Ammeter 0-500ma

TOOLS: Standard Electricians Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-6.	NOTE: Generator connected to operate as a cumulative compound generator.
2. Turn on AC motor.	NOTE: Speed kept constant.
3. Adjust field rheostat and resistive load to obtain the rated output voltage at the rated output current.	
4. Load generator through 8 steps from 0 to 125% of its rated load current. Record in table 1 the load current, I_L , the terminal voltage V , and the field current I_f for each step.	
5. Decrease the load to zero. Turn off AC power	
6. Reverse the series field winding S1 and S2.	NOTE: This will give a differential compound generator.
7. Without changing field rheostat start loading generator from zero in the same steps as in procedure 4 for as many steps as you can. Record in table 2. Decrease load to zero, turn off power.	
8. Remove the series field winding.	NOTE: This will give a shunt generator.

COMPETENCE - PROCEDURES/STEPS

TEACHING/LEARNING ACTIVITIES

9. Repeat procedure steps 4. Record results in table 3.
10. Dismantle.

METHOD OF EVALUATION:

1. Check the tables and values recorded.
2. Ask students to draw appropriate conclusion.

227

TABLE 1

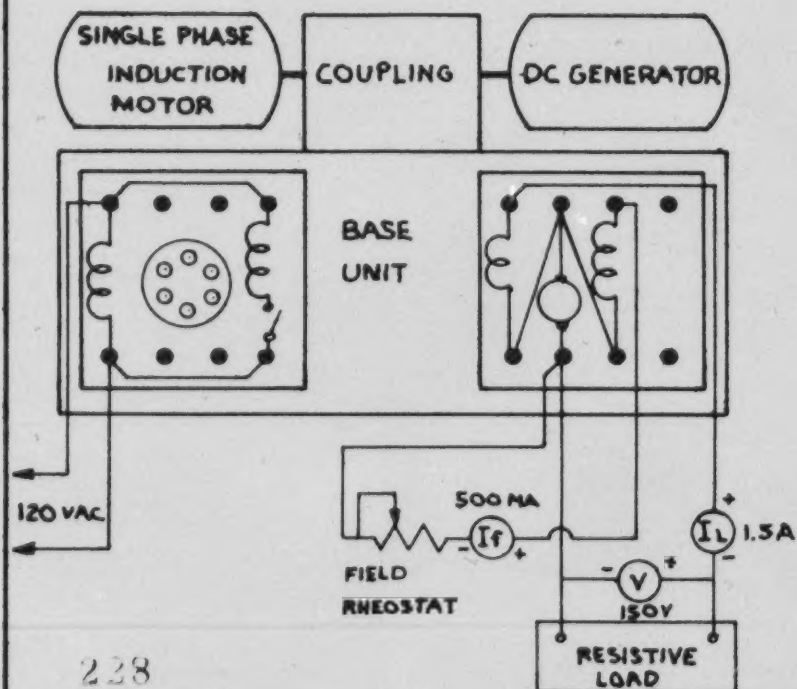
I_L AMP	VOLT	I_f MA

TABLE 2

I_L AMP	VOLT	I_f MA

TABLE 3

I_L AMP	VOLT	I_f MA



228

D.C. COMPOUND GENERATOR

229

D-3-6

JOB: Wire and Operate a D.C. Shunt Motor

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-7

COURSE: Electrical Occupations

DRAWING NO: D-3-7

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Base Unit 40 Watt Lamp & Lamp Holder
Prony Brake DC Voltmeter 0-150V
DC Motor DC Ammeter 0-5A
Hand Tachometer SPST Switch

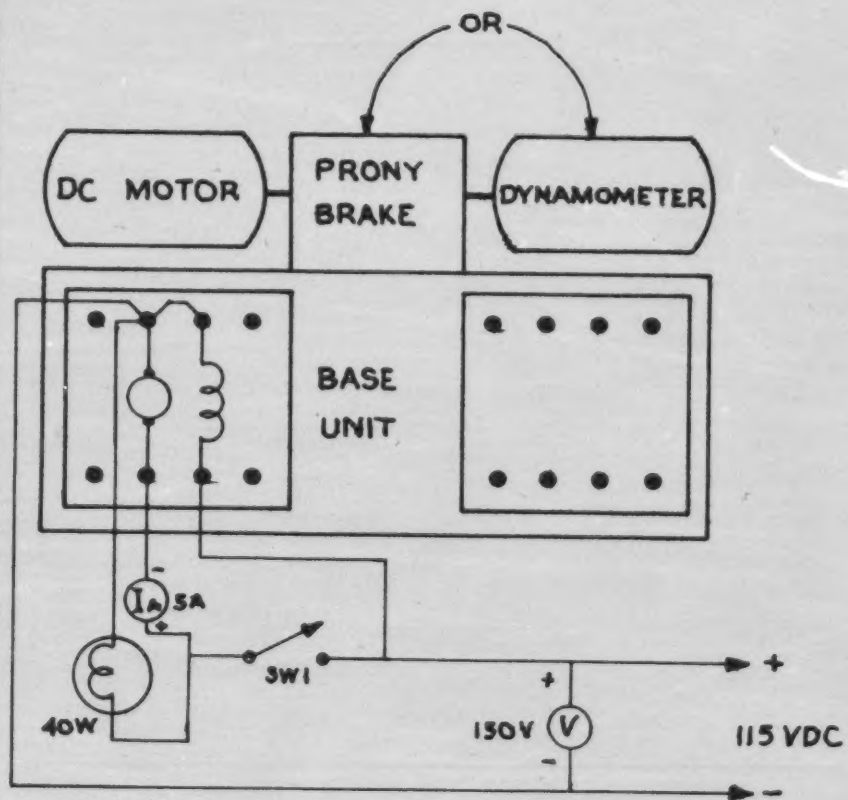
TOOLS: Standard Electricians Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-7.	NOTE: Motor is connected to operate as a shunt generator.
2. Install prony brake with belt slack.	NOTE: This is used as a load for motor.
3. With switch SW1 closed turn on DC power.	NOTE: Have a DC supply to equal the rated line voltage of motor. OBSERVE: The deflection of the ammeter in the armature circuit at the instant of starting.
4. Quickly open switch SW1.	OBSERVE: At the instance check the deflection of the ammeter and the brilliance of the lamp.
5. Turn off the DC motor. Remove the 40 watt lamp. With switch SW1 closed, turn on the DC motor. Gradually load the motor with prony brake through 8 steps from 0 to 56 oz.	NOTE: Deep line voltage constant.
6. Record the following for each step in table 1; (a) load, (b) speed, (c) armature current I_A .	
7. Reduce the load to zero turn off the DC motor.	

8. Dismantle job.

METHOD OF EVALUATION:

1. Check the values in tables.
2. Have students explain:
 - a. counter E.M.F.
 - b. how torque varies.



LOAD OZ	N RPM	I_a AMPS	T oz-in

D.C. SHUNT MOTOR

233

D-3-7

232

JOB: Wire and Load a D.C. Shunt Motor

UNIT III: Motor Generators

COURSE: Electrical Occupations

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Base Unit DC Voltmeter 0-150V
Prony Brake DC Ammeter 0-5A
DC Motor DC Ammeter 0-500ma

TOOLS: Standard Electricians Tool Pouch

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-8

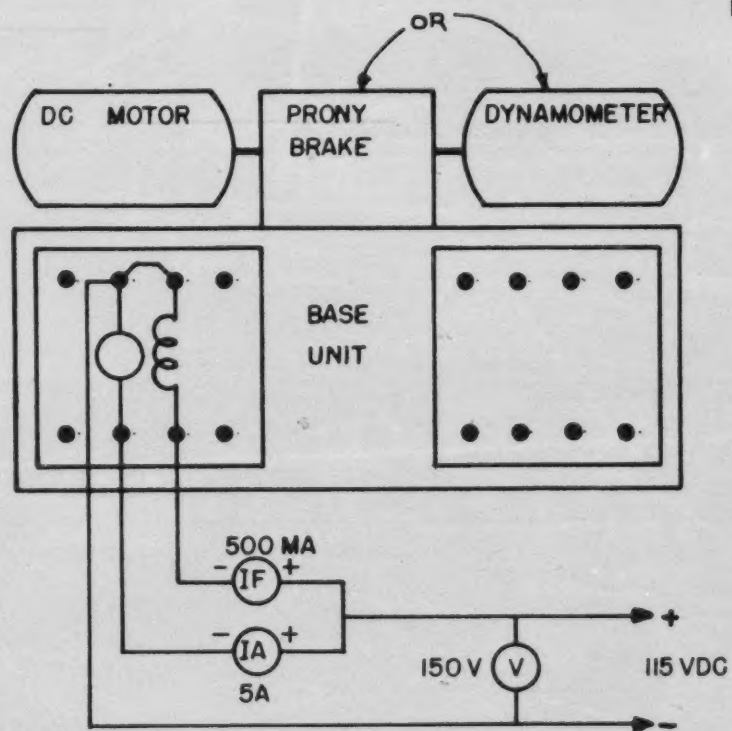
DRAWING NO: D-3-8

Hand Tachometer.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-8.	NOTE: DC motor is to be connected as a shunt motor.
2. Install the prony brake with belt slack. Turn on the DC motor.	NOTE: Motor should rotate counter clockwise.
3. Load motor through 8 steps from no load to 56 oz. Record each step in table 1: (a) load, (b) speed N , (c) line voltage, (d) armature current I_A , (e) field current I_f .	NOTE: Line voltage kept constant.
4. Reduce the load to zero. Turn off motor.	
5. Dismantle job.	

METHOD OF EVALUATION:

1. Check values of chart.
2. Have students explain why does the torque remain constant in a shunt generator.



235

LOAD OZ									
N RPM									
V VOLTS									
IA AMPS									
IF AMPS									
IL AMPS									
PIN WATTS									
T OZ-IN									
HP									
POUT WATTS									
EFF %									

D.C. SHUNT MOTOR

236

D-3-8

JOB: Wire and Operate a D.C. Series Motor

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-9

COURSE: Electrical Occupations

DRAWING NO: D-3-9

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Base Unit Hand Tachometer
 Prony Brake DC Voltmeter 0-150V
 DC Motor DC Ammeter 0-10A

TOOLS: Standard Electrician's Tool Pouch

SAFETY PRECAUTIONS:

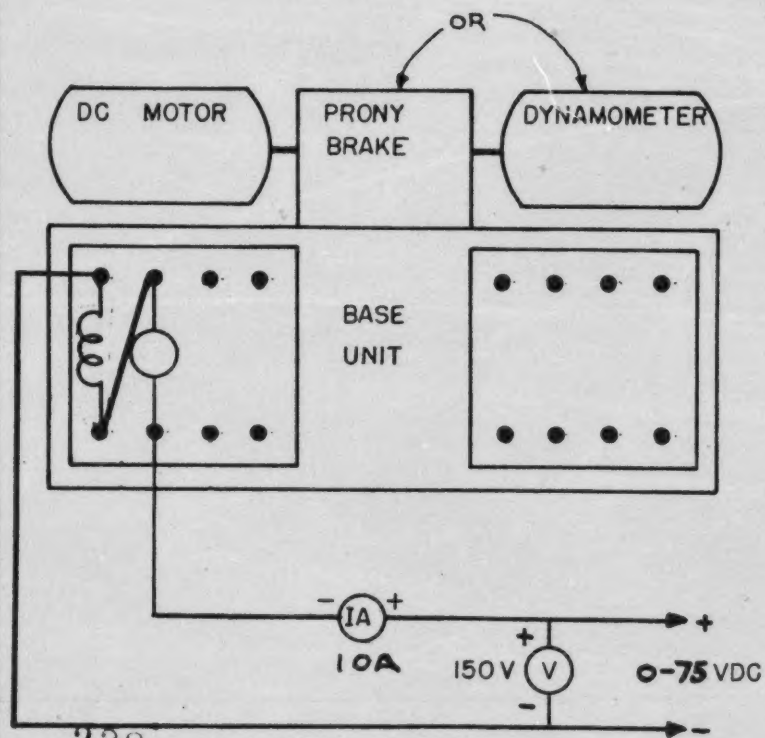
A series motor must always be started under sufficient load to prevent excessive speed

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-9.	NOTE: Motor is connected to operate as a series motor.
2. Install prony brake.	NOTE: Make belt fairly tight to the pulley.
3. Slowly increase the voltage and ensure rotates in a direction appropriate for prony brake. Gradually increase the voltage to 75 volts and at the same time, check the speed of the motor to its near rated speed (1725 R.P.M.). Gradually increase the load to 52 oz.	NOTE: Make sure DC voltage output of power is at its zero setting. NOTE: Can change direction of rotating by changing the loads of the series field or armature.
4. Gradually reduce the load through 8 steps 52 oz to 8 oz. Record the following for each step in table 1: (a) load, (b) speed N, (c) Line Voltage V, (d) Armature Current I_A .	NOTE: Maintain the applied voltage at 75 volts throughout. NOTE: Any variation must be correct for each load.
5. Turn off motor.	
6. Dismantle.	CAUTION: Do not permit the speed to exceed 3500 R.P.M.

METHOD OF EVALUATION:

Check table.

LOAD OZ									
N RPM									
V VOLTS									
IA AMPS									
PIN WATTS									
T OZ-IN									
HP									
POUT WATTS									
EFF %									



D.C. SERIES MOTOR

D-3-9

JOB: Wire and Load a D.C. Series Motor

UNIT III: Motor Generators

COURSE: Electrical Occupations

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Base Unit
DC Compound Motor
Series of Field Resistors

Stop Watch
Switch Unit
DC Voltmeter 0-150V

TOOLS: Standard Electricians Tool Pouch

JOB SHEET
IDENTIFICATION CODE

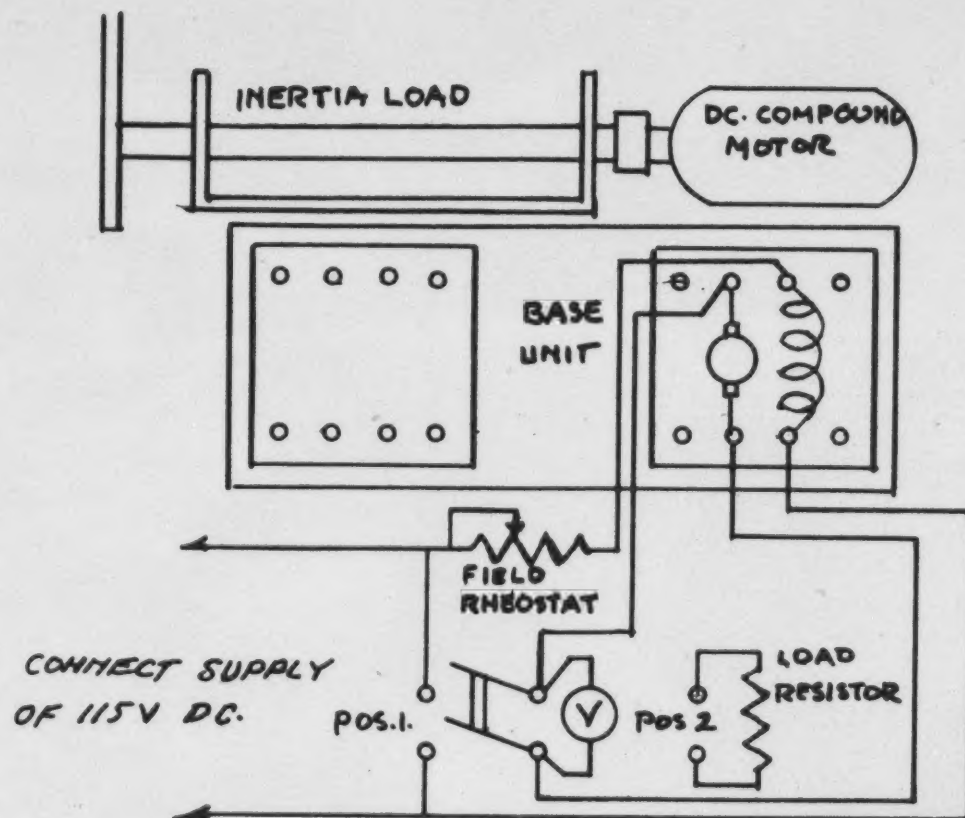
JOB NUMBER: J-3-10

DRAWING NO: D-3-10

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Set up job, secure and wire as in D-3-10.	NOTE: Motor is to be connected as a shunt motor.
2. Install the inertia load.	NOTE: Equipment information sheet on Inertia Load.
3. With switch in position 1 turn on motor. When the motor runs up to rated speed turn motor off.	NOTE: The normal time for the armature to come to a stand still.
4. With no resistance in switch position 2 start the motor, with the switch in position 1. When the motor runs up to rated speed throw switch quickly to position 2.	NOTE: The voltmeter reading and the change as speed decreases.
5. Insert different loading resistance in position 2 and repeat procedure 4. Record results in table 1.	NOTE: Corresponding times to stand still.
6. Repeat procedure 4 and 5 with inertia load removed.	

METHOD OF EVALUATION:

1. Check the tables values.
2. Have students explain what method is best to use and why.



241

SCALE:		APPROVED BY:	DRAWN BY
DATE:			REVISED
D.C. SERIES MOTOR			
DRAWING NUMBER			242

D-3-10

JOB: Wire and Operate a D.C. Compound Motor

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-11

COURSE: Electrical Occupations

DRAWING NO: D-3-11

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Base Unit Hand Tachometer
 Prony Brake DC Voltmeter 0-105V DC Ammeter
 DC Motor DC Ammeter 0-5A 0-500 ma

TOOLS: Standard Electricians Tool Pouch

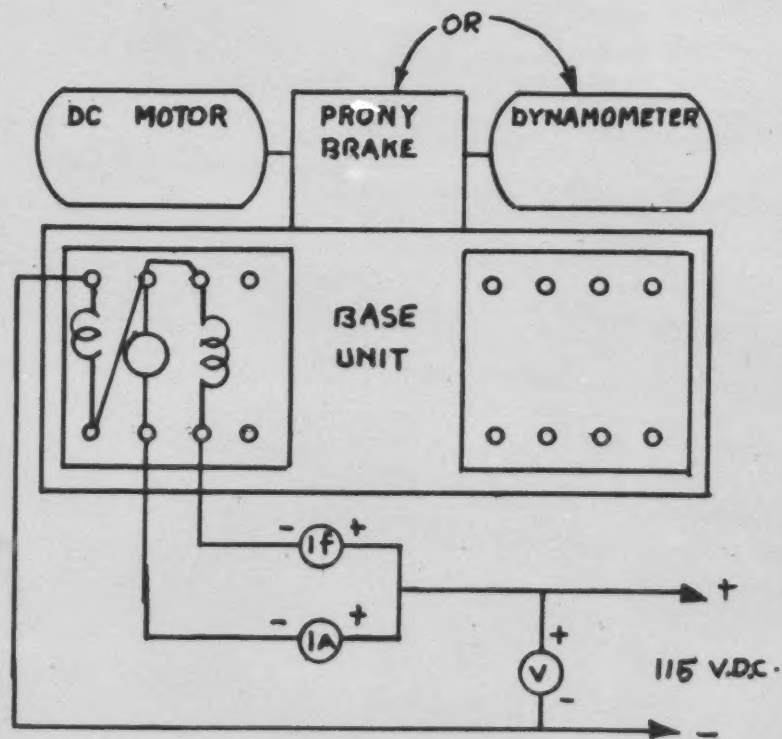
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-11.	NOTE: Motor is to be connected as a cumulative compound motor.
2. Install prony brake.	NOTE: Have belt slack.
3. Turn on motor.	NOTE: Line voltage should be as rated for motor with no load. CAUTION: Motor should rotate in an appropriate direction for the prony brake.
4. Load the motor through 8 steps from no.1 load to 56 oz. Record the following for each step in table 1: (a) load, (b) speed N, (c) line voltage V, (d) Armature Current I_A , (e) Field Current I_f .	NOTE: Line voltage kept constant.
5. Reduce the load to zero.	
6. Turn off motor.	
7. Break down job.	

METHOD OF EVALUATION:

1. Check values on tables.
2. Have students:
 - a. Explain what type of motor was this.
 - b. Draw appropriate conclusions.

LOAD OZ							
N RPM							
V VOLTS							
I _A AMPS							
I _f AMPS							
I _L AMPS							
P _{IN} WATTS							
T OZ-IN							
HP							
P _{OUT} WATTS							
EFF %							

TABLE 1.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
D.C. COMPOUND MOTOR		
DRAWING NUMBER		245
D-3-11		

JOB: Wire and Load a D.C. Compound Motor

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-12

COURSE: Electrical Occupations

DRAWING NO: D-3-12

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT:	Base Unit	Hand Tachometer	DC Ammeter
	DC Motor	SPST Switch	0-5A
	Armature Speed Control	DC Voltmeter	DC Ammeter
	Field Rheostat	0-150V	0-500ma

TOOLS: Standard Electricians Tool Pouch

SAFETY PRECAUTIONS:

Never remove the shunt field from a shunt DC motor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up job, secure and wire as in D-3-12.	NOTE: Motor to be connected as a shunt motor.
2. With switch SW1 closed turn on the DC motor. Observe the deflection of the ammeter in the armature circuit at the instant of starting.	NOTE: Make sure that the resistance in the field rheostat is a minimum and the resistance in the armature speed controller is a maximum. NOTE: Line voltage at rated value of motor.
3. Vary the armature voltage by means of the armature speed controller through 8 steps from 0 to its rated voltage. Record the following for each step in table 1 (a) Armature Voltage V_A , (b) Speed N.	NOTE: Keep field current constant at its rated value.
4. Vary the field current by means of the field rheostat through 8 steps. Record the following in table 2: (a) Field Current I_f , (b) Speed N.	NOTE: Keeping the armature voltage constant at its rated value.
5. Reduce the resistance in the field rheostat for maximum field current.	NOTE: Do not allow the speed to exceed 3000 R.P.M.

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
6. CAUTION: This procedure is to open the shunt field winding only 3 seconds.	CAUTION: Care must be taken not to leave the shunt field open any longer than <u>3 seconds</u> .
7. Open and close switch SW1 QUICKLY. Observe the deflection of the ammeters and the effect on the speed.	NOTE: Have instructor present when performing this part.
8. Turn off DC motor.	
9. Dismantle job.	

METHOD OF EVALUATION:

1. Check values on tables.
2. Have student explain:
 - a. What must you look for in a shunt motor.
 - b. Use of a shunt motor.

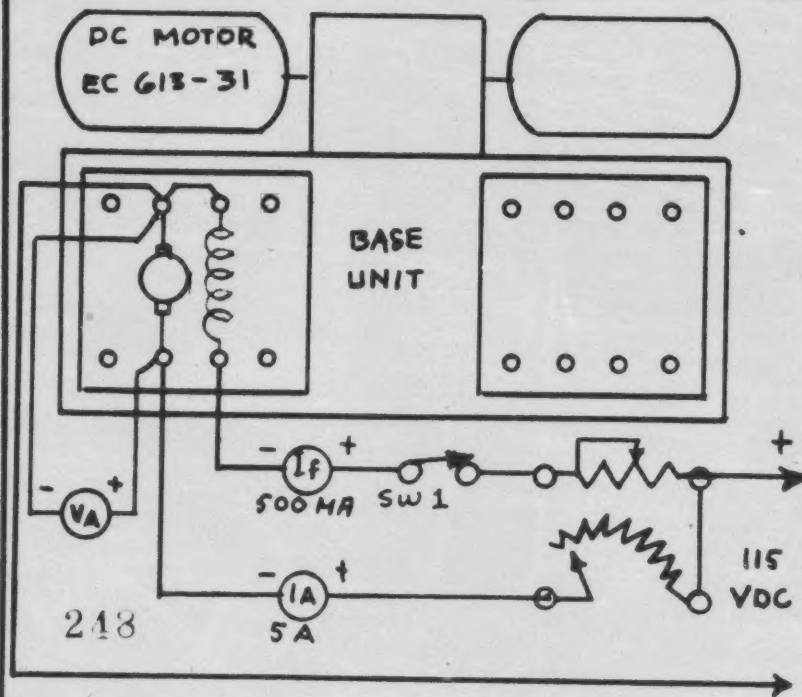
TABLE 1

V _A VOLTS		
N R.P.M.		

TABLE 2.

I _f AMP		
N R.P.M.		

309



SCALE:

APPROVED BY:

DRAWN BY

DATE:

REVISED

D.C. COMPOUND MOTOR

249

DRAWING NUMBER

D-3-12

JOB: Connect and Operate an Alternator

UNIT III: Motor Generators

COURSE: Electrical Occupations

MATERIAL: 2 Escutcheon Plates
8 Patch Cords

EQUIPMENT: Base Unit
Synchronous Machines
Tachometer

AC Voltmeter 0-250V
Field Power Supply
DC Motor

DC Ammeter
0-500ma

TOOLS: Standard Electricians Tool Pouch

JOB SHEET

IDENTIFICATION CODE

JOB NUMBER: J-3-13

DRAWING NO: D-3-13

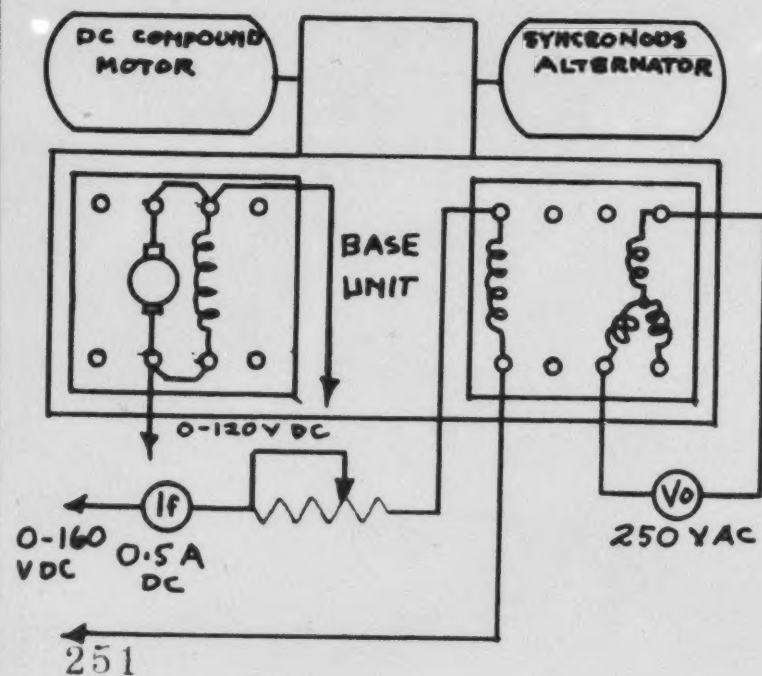
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up, secure and wire as in D-3-13.	NOTE: Inspect the alternator check construction, ventilation and method of lubrication.
2. Make sure that the field current to the alternator is adjusted to near zero.	NOTE: To reduce current turn field rheostat to maximum or reduce the DC voltage to the alternator field.
3. Turn on the DC motor and adjust the voltage until the alternator is running at rated speed 1800 R.P.M. Gradually increase the alternator field current in steps until the armature voltage reaches 280 volts. Record field current and armature voltage for each step in Table 1.	
4. Reduce the field current to zero then adjust the voltage to DC motor until the alternator is running at half rated speed of 900 R.P.M. Gradually increase alternator field current in steps until it reaches the same value as in procedure (3) and record each step in table 1.	
5. Turn DC motor and DC field supply off.	
6. Dismantle job.	

METHOD OF EVALUATION:

1. Check table values.
2. Ask some specific points about the Synchronous Alternator.

1800 RPM		900 RPM	
I_f mA	V_o V	I_f mA	V_o V

TABLE 1



SCALE:			APPROVED BY:		DRAWN BY	
DATE:					REVISED	
ALTERNATOR						
DRAWING NUMBER						252
D-3-13						

JOB: Connect a Synchronous Alternator
to a Power System

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-14

COURSE: Electrical Occupations

DRAWING NO: D-3-14
D-3-14A

MATERIAL: 2 Escutcheon Plates
8 Patch Cords

EQUIPMENT: Base Unit
Input Control Unit
Field Rheostat
D.C. Compound Motor
Synchronous Alternator

TOOLS: Standard Electrician's Tool Pouch

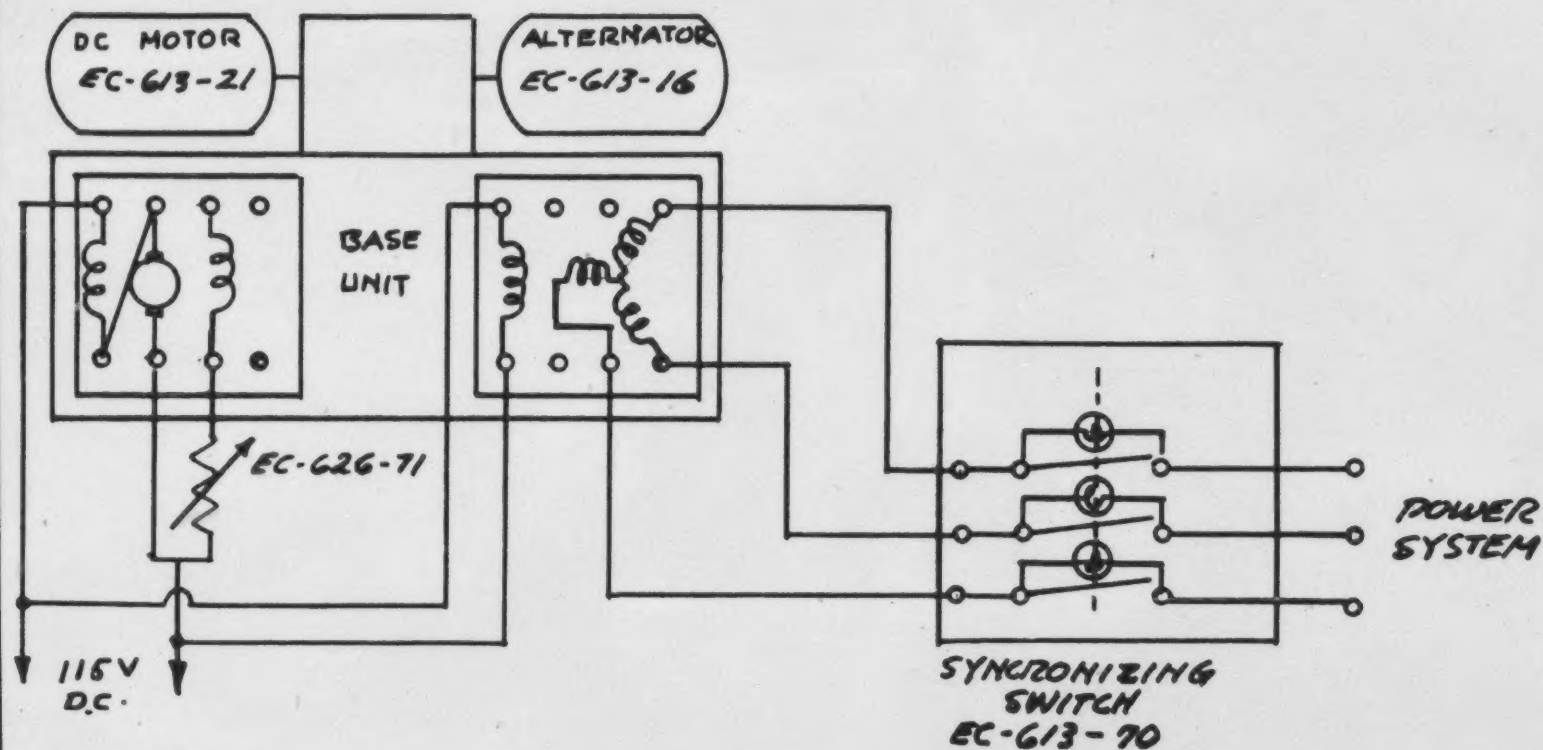
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect, secure and wire as in D-3-14.	
2. The synchronizing switch in the off position, turn on the D.C. motor such that the alternator is running at rated speed of 1800 R.P.M.	NOTE: The three lamps are straight-connected between corresponding phases.
3. Switch on DC field supply to the alternator and adjust the alternator field rheostat to given rated generated voltage 208 volts.	NOTE: Approximately equal to the line voltage of the power system.
4. Close switch #1.	
5. Check the lamps for phase sequence.	NOTE: If the lamps go bright and dark in unison the phase sequence of the voltage of the incoming alternator is correct. If the lamps alternate in a brilliance in a cyclic manner, the phase sequence of the voltage of the incoming alternator is reversed. Open switch S1 and switch off the D.C. field supply. Then interchange any two of the three terminals from the incoming alternator to obtain the correct phase sequence.

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
6. Adjust the speed of the incoming alternator to make the lamps go bright and dark at their lowest rate.	NOTE: Do not try for exact equality in frequency between the incoming alternator and the power system as this could produce a fixed phase difference between corresponding voltage.
7. The correct instant to close the paralleling switch is when the lamps are dark.	NOTE: The voltages are equal in magnitude and phase. The alternator is now connected in parallel with the power system.
8. To remove the incoming alternator from the power system open the paralleling switch.	NOTE: <u>DO NOT</u> close the paralleling switch again without observing the correct timing as previously explained.
9. Repeat the synchronizing procedure several times until some skill is acquired.	
10. Open the paralleling switch, open switch S1, and switch off the DC field supply. Then turn off DC motor.	
11. Connect the DC motor and alternator as in D-3-14.	NOTE: One lamp is straight - connected between corresponding phases while the other two are cross connected. Interchange the two leads of the two lamps at the terminals of the paralleling switch.
12. Repeat procedures (2), (3), and (4).	
13. Dismantle job.	

METHOD OF EVALUATION:

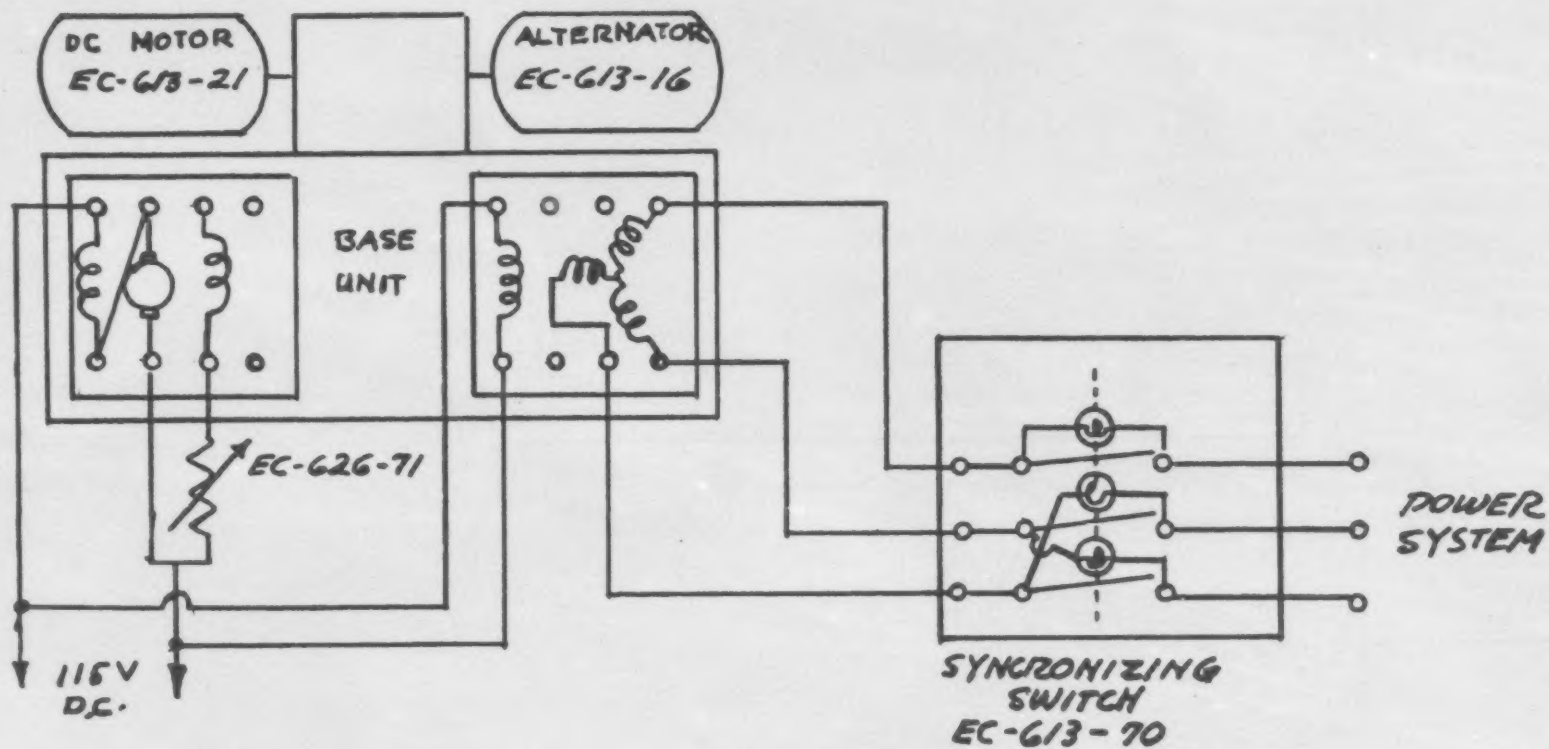
1. Observe the switching of the alternators.

317



255

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
SYNCHRONOUS ALTERNATOR		
		DRAWING NUMBER
		D-3-14 256



257

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
SYNCHRONOUS ALTERNATOR		
258		DRAWING NUMBER D-3-14A

JOB: Install, Connect and Operate a
Polyphase Motor

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-15

COURSE: Electrical Occupations

DRAWING NO: D-3-15

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Base Unit and Input Control
Polyphase Induction Motor

SPST Knife Switch
Hand Held Tachometer

TOOLS: Standard Electrician's Tool Pouch

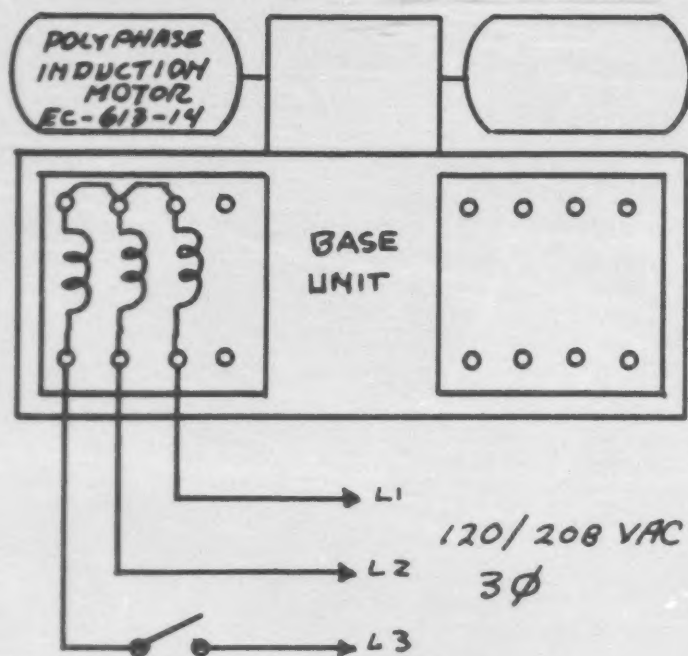
SAFETY PRECAUTIONS:

The voltages involved in these experiments are relatively large and typical of industry, when handled improperly, they can be dangerous

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect as in D-3-15.	NOTE: Inspect the motor details of construction, ventilation and method of lubrication.
2. With knife switch closed turn power on, measure speed, and turn power off.	NOTE: Direction of rotation.
3. Interchange leads L1 and L2. Turn power on. Turn power off.	NOTE: Direction of rotation.
4. Interchange leads L2 and L3. Turn power on. Turn power off.	NOTE: Direction of rotation.
5. With knife switch open briefly turn power on. Turn power off.	NOTE: Results.
6. Close knife switch. Turn power on, open knife switch. Turn power off.	NOTE: Results.
7. Dismantle job.	

METHOD OF EVALUATION:

Check to see if the students know how to reverse a polyphase motor.



260

SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
WOUND ROTOR MOTOR		
		DRAWING NUMBER
		D-3-15 261

JOB: Install, Connect and Operate a
Wound Rotor Motor

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-16

COURSE: Electrical Occupations

DRAWING NO: D-3-16

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Base Unit
Input Control
Wound Rotor Motor

Prony Brake
Wound Rotor Speed Controller
Ohmmeter (low resistance)

Strobe Light
2 Switch Units
Tachometer

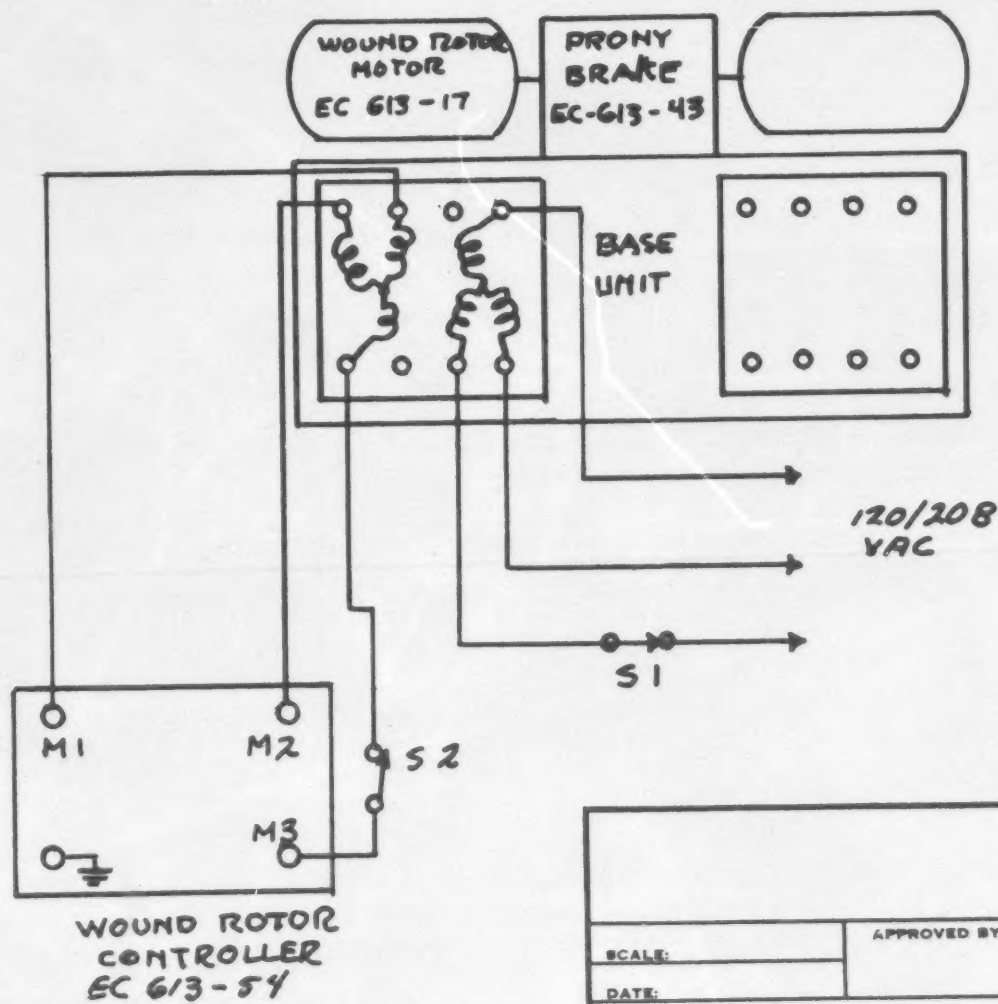
TOOLS: Standard Electrician's Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up, secure and wire as in D-3-16.	
2. Set the controller to start. Turn power on. Turn off power.	
3. Interchange T1 and T3 of the starter terminals. Repeat procedure (2).	NOTE: This will be maximum resistance; direction of rotation and measure of speed should be noted.
4. Interchange leads L2 and L3 of the starter terminals and repeat procedure (2).	
5. Interchange leads M1 and M2 of the rotor terminals and repeat step (2).	NOTE: How the direction of rotation compares with the original direction.
6. Repeat (5) and then set the controller to run position for zero resistance. Turn power off.	NOTE: Measure the no load speed.
7. Install prony brake with operating knob in start position, turn on motor.	NOTE: Keep belt slack. Check rotation to see if its appropriate for prony brake, if not reverse.
8. Slowly turn the operating knob to run position, load the motor with prony brake to rated load 33 oz. Repeat with each setting of the wound rotor controller. Remove the load, turn off power.	NOTE: Do not have external resistance in the rotor circuit. Measure the speed.

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
9. Use a strobe light to observe the following: - With S1 open and S2 closed turn power on/turn power off. - With S1 closed and S2 open turn power on/turn power off. - With S1 and S2 closed turn power on, open S1, turn power off. - With S1 and S2 closed turn power on, open S2, turn power off.	NOTE: Note the results of (a) through (d).
10. Open all rotor lines, turn power on. Measure the voltage between each pair of rotor terminals. Turn the rotor by hand to various positions.	NOTE: The rotor will be stationary. Note whether any change occurs in the voltage between a pair of rotor terminals.
11. Leave the rotor lines open. Apply a single phase voltage of rated value to a pair of stator terminals. Measure voltage between each pair of rotor terminals. Turn the rotor by hand to various positions.	NOTE: Whether any change occurs in the voltage between a pair of rotor terminals.
12. Turn power off, dismantle.	

METHOD OF EVALUATION:

- Ask:
- for some specific points the students observed about the wound rotor motor and controller.
 - for the effect of interchanging leads in the stator.
 - what did they observe with the strobe light.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
WOUND ROTOR MOTOR		
265		DRAWING NUMBER D-3-16

JOB: Install and Connect a Split Phase Induction Motor, Capacitor Start

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-17

COURSE: Electrical Occupations

DRAWING NO: D-3-17

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Base Unit Input Control
AC Ammeter Prony Brake Unit
Switch Unit Tachometer

Split Phase Motor
Capacitor Start Motor
Universal Current Transformer

TOOLS: Standard Electrician's Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up, wire, and secure as in D-3-17.	NOTE: Construction, methods of ventilation, lubrications, and starting.
2. Open SW1, turn power on.	NOTE: This will take the starting windings out. Motor will hum but no rotation. <u>DO NOT</u> leave your hand on the shaft.
3. Quickly turn the shaft clockwise with your hand. Turn power off.	NOTE: Direction.
4. Repeat procedure (3) by turning counter-clockwise. Turn power off.	NOTE: Direction.
5. Close SW1. Turn power on; turn power off.	NOTE: Starting winding is parallel with main winding.
6. Interchange leads of supply to the winding. Repeat procedure (5).	NOTE: Direction.
7. Interchange leads to the starting winding from the main winding. Repeat procedure (5).	
8. Interchange leads of supply to the main windings. Repeat procedure (5), restore the connection as in procedure (5).	
9. Interchange leads to the main winding from the starting winding. Repeat procedure (5). Interchange leads to the main winding. Repeat procedure (5).	

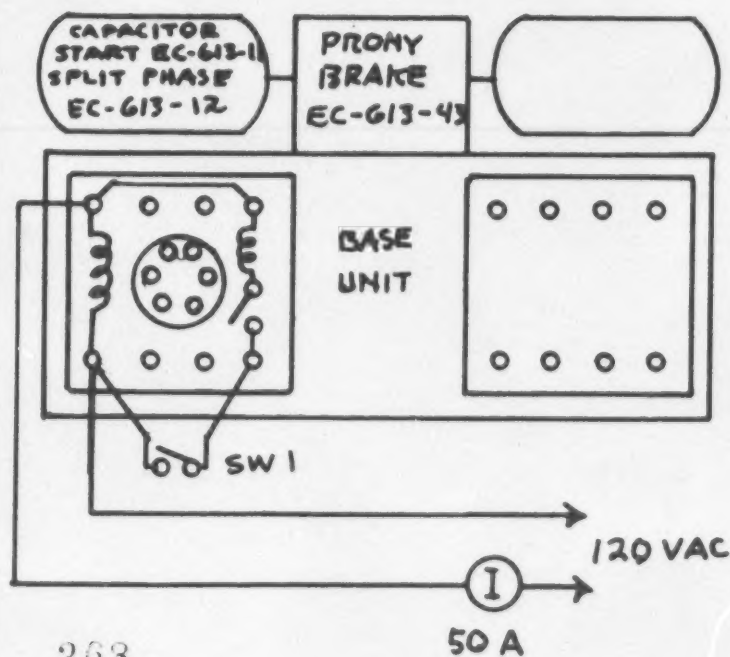
COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
10. Install prony brake with belt slack. Measure the no load speed of the motor; load the motor with the prony brake to rated load (33 oz.); measure the speed and current. Turn power off.	NOTE: Check rotation to see if direction is appropriate.
11. Tighten prony brake such that the motor will not start when rated voltage at rated frequency is applied. Turn power on. Measure starting current and torque. Turn power off as soon as measurements are made.	NOTE: Do not leave power on too long.
12. Dismantle.	

METHOD OF EVALUATION:

The instructor will observe the student performing this job.

TABLE 1	DIRECTION OF ROTATION
PROCEDURE (4)	
" (3)	
" (4a)	
" (4b)	
" (5a)	
" (5b)	
" (6a)	
" (6b)	

TABLE 2 1-3/4	SPLIT PHASE	CAPACITOR START
NO LOAD SPEED		
RATED SPEED		
RATED TORQUE		
RATED CURRENT		
STARTING TORQUE		
STARTING CURRENT		



SCALE:		APPROVED BY:	DRAWN BY
DATE:			REVISED
SPLIT PHASE INDUCTION MOTOR, CAPACITOR START			
268		269	DRAWING NUMBER D-3-17

JOB: Install and Connect A Shaded Pole
Induction Motor

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-18

COURSE: Electrical Occupations

DRAWING NO: D-3-18

MATERIAL: Escutcheon Plate
8 Patch Cords

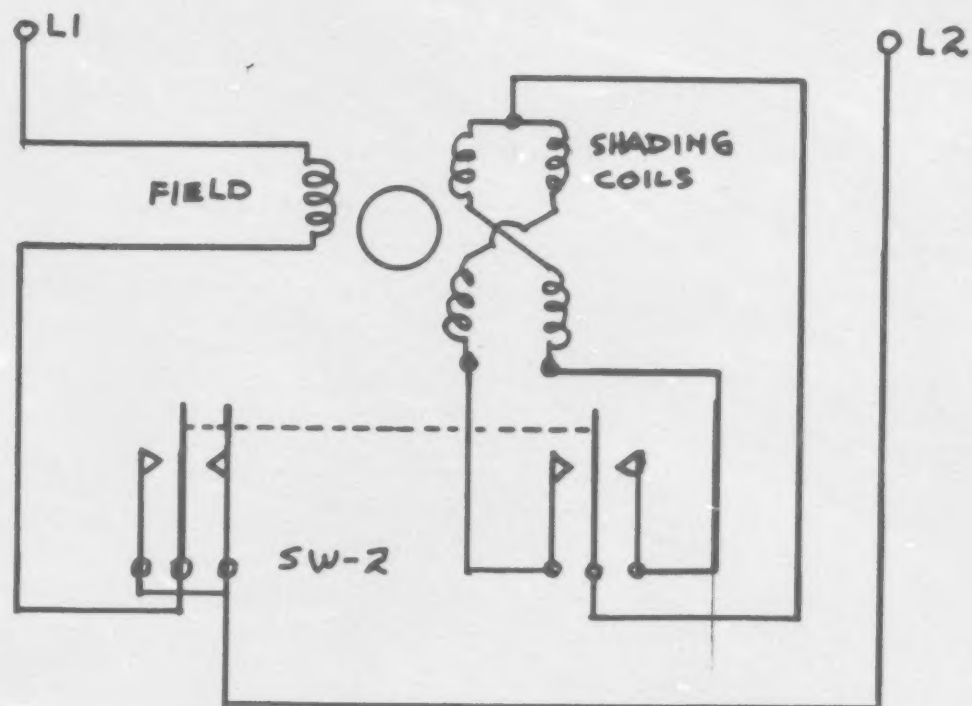
EQUIPMENT: Shaded Pole Motor
Double Pole, Double Throw Switch

TOOLS: Standard Electrician's Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect and wire as in D-3-18.	
2. Place SW2 switch in the off position.	NOTE: Check all connections.
3. Apply power.	
4. Turn SW2 switch to the on position in one direction.	
5. Turn SW2 switch off.	NOTE: Direction of rotation as it comes to a stop.
6. Turn SW2 switch in the other direction to on.	
7. Turn SW2 switch off.	NOTE: Direction of rotation as it comes to a stop.
8. Dismantle.	

METHOD OF EVALUATION:

The instructor will observe the student as he performs this job.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
A SHADED POLE INDUCTION MOTOR		
		DRAWING NUMBER
		D-3-18

JOB: Install and Connect a Universal Motor

UNIT III: Motor Generators

COURSE: Electrical Occupations

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Universal Motor
Double Pole, Double Throw Switch

TOOLS: Standard Electrician's Tool Pouch

JOB SHEET
IDENTIFICATION CODE

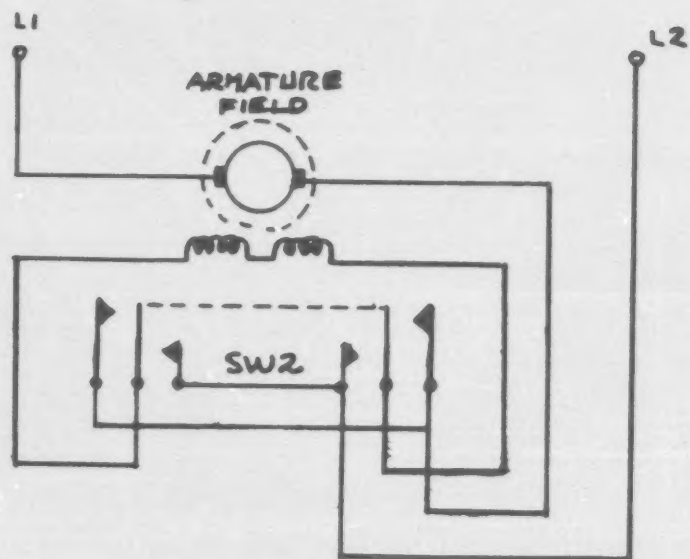
JOB NUMBER: J-3-19

DRAWING NO: D-3-19

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up and connect as D-3-19. 2. Place SW2 switch in off position. 3. Apply power. 4. Operate SW2 switch to on position. 5. Turn SW2 switch to off. 6. Turn SW2 switch in the <u>other</u> to on. 7. Turn SW2 switch off.	NOTE: Check all connections. NOTE: Motor should rotate. NOTE: Rotation as it comes to a stop. NOTE: Direction of rotation as it comes to a stop.

METHOD OF EVALUATION:

1. If assignment is carried out they should be able to tell you what happened when SW2 was operated.
2. Direction CW and CCW rotation.



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
UNIVERSAL MOTOR		
		DRAWING NUMBER
		D-3-19

JOB: Install and Determine the Efficiency
of A Basic Transformer

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-20

COURSE: Electrical Occupations

DRAWING NO: D-3-20

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: Demonstration Transformer
Input Control Unit
2 AC Voltmeters 0-150V

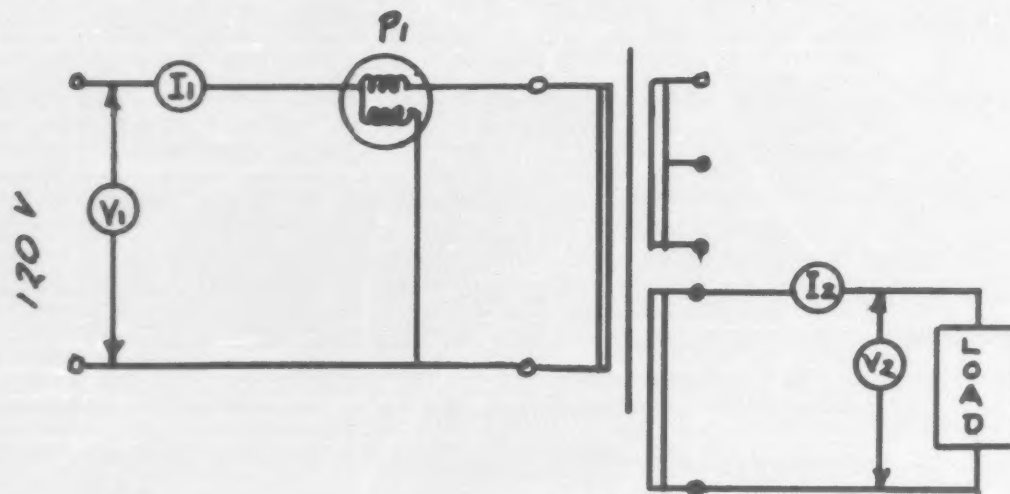
2 AC Ammeters 0-2.5A
Resistive Load

TOOLS: Standard Electrician's Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect the transformer as in D-3-20.	
2. Turn power on. Apply the rated voltage to primary winding. Secondary has no load.	
3. Load the transformer by the resistance load through 8 steps from 0 to 125% of its rated load. Record each step in Table 1: (a) Primary voltage V_1 (b) Primary current I_1 (c) Power input P_1 (d) Secondary voltage V_2 (e) Secondary current I_2	
4. Decrease the load to zero. Turn power off.	

METHOD OF EVALUATION:

The instructor will check the recorded voltages.



277

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
TRANSFORMER		
		DRAWING NUMBER
		D-3-20

JOB: Install, Wire and Operate Two
Single Phase Transformers in
Parallel

UNIT III: Motor Generators

COURSE: Electrical Occupations

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: 2 Demonstration Transformers
3 AC Ammeters 0-2.5/5A
DPDT Switch

TOOLS: Standard Electrician's Tool Pouch

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-21

DRAWING NO: D-3-21

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect transformer as in D-3-21.	NOTE: Transformer B is connected in parallel with A.
2. Before switching on make sure that switches SW1 and SW2 are open.	
3. Turn power on and apply the rated voltage to the primary windings with the transformers on no-load.	
4. Close switch SW1 in position 1. Record the voltage V_o in Table 1.	NOTE: In one or the other position the voltage will read twice the terminal voltage.
5. Close switch SW1 in position 2. Record the voltage V_o in Table 1.	
6. With the voltage V_o equal to zero, close SW2.	NOTE: Never close SW2 if the voltage is more than 10% of the terminal voltage. Now transformer B is in parallel with A.
7. Load the transformer using the resistive load through 8 steps from 0 to 125% of the rated current. Record each step in Table 2.	
(a) Current in Trans A, I_A . (b) Current in Trans B, I_B . (c) Current in Load I_L . (d) Voltage across Load V_L .	
8. Decrease the load to zero. Turn off power. Dismantle.	

METHOD OF EVALUATION:

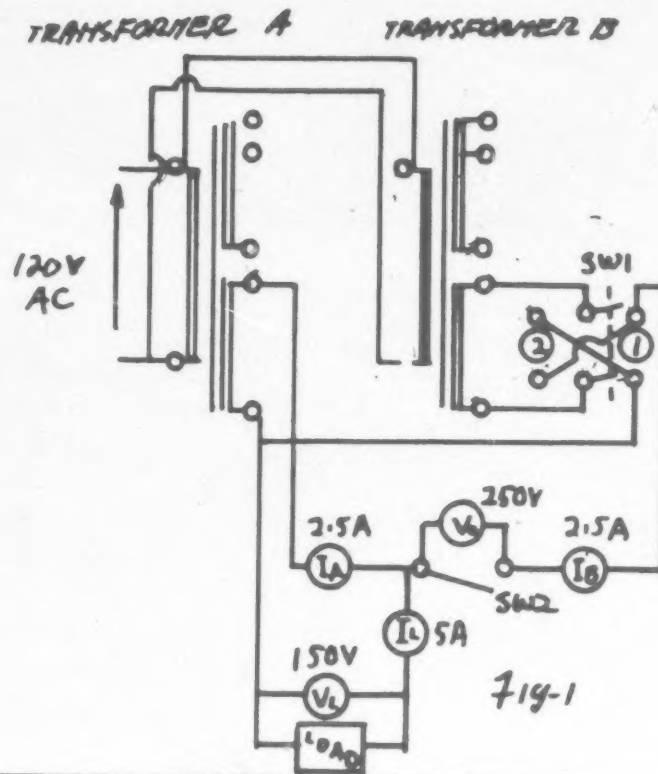
What must be done when you parallel two transformers?

TABLE #1

V_o WITH SWITCH SW1 IN POS - 1	VOLTS
V_o " " SW1 " " - 2	VOLTS

TABLE #2

I_a AMPS	I_b AMPS	I_L AMPS	V_L VOLTS



SCALE:

APPROVED BY:

DRAWN BY:

DATE:

REVISED:

TWO SINGLE PHASE TRANSFORMERS IN PARALLEL

DRAWING NUMBER

D-3-21

JOB: Install and Connect Three Single
Phase Transformers to Delta-Delta

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-22

COURSE: Electrical Occupations

DRAWING NO: D-3-22

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: 3 Demonstration Transformers
Demonstration 3Ø Transformer
A 3-Lamp Board

3 Lamps 40 Watt 120V
Input Control Unit

TOOLS: Standard Electrician's Tool Pouch

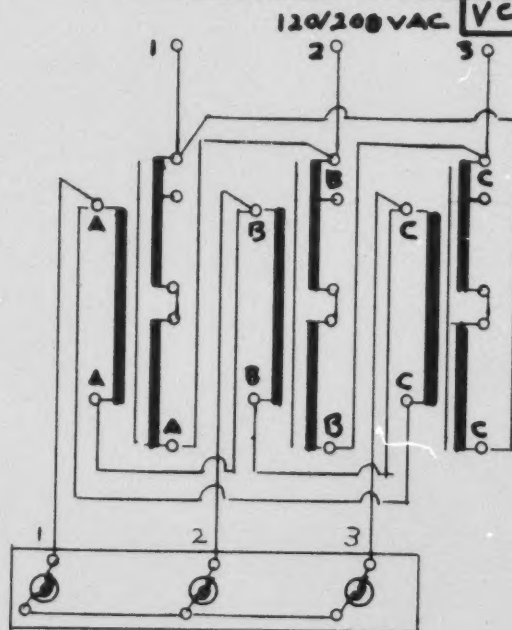
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

1. Connect the three single phase transformers as in D-3-22.
2. Turn the power on and apply rated voltage to the primary windings with the secondary windings connected to a three phase load as specified.
3. Using a voltmeter measure and record in Table 1:
Primary Line Voltage
Secondary Line Voltage
Secondary Phase Voltage
4. Turn off power. Dismantle.

METHOD OF EVALUATION:

The instructor will check the recorded voltages in Table #1.

CONNECTIONS		DELTA DELTA	DELTA WYE	WYE WYE	WYE DELTA	OPEN DELTA
PRIMARY LINE VOLTAGE	V12					
	V23					
	V31					
PRIMARY PHASE VOLTAGE	VAA					
	VBB					
	VCC					
SECONDARY LINE VOLTAGE	V12					
	V23					
	V31					
SECONDARY PHASE VOLTAGE	VAA					
	VBB					
	VCC					



Delta Delta connection

SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
THREE SINGLE PHASE TRANSFORMERS - DELTA-DELTA		
		DRAWING NUMBER
		D-3-22

JOB: Install and Connect Three Single
Phase Transformers To Delta-Wye

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-23

COURSE: Electrical Occupations

DRAWING NO: D-3-23

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: 3 Demonstration Transformers
Demonstration 3Ø Transformer
A 3-Lamp Board

3 Lamps 40 Watt 120V
Input Control Unit

TOOLS: Standard Electrician's Tool Pouch

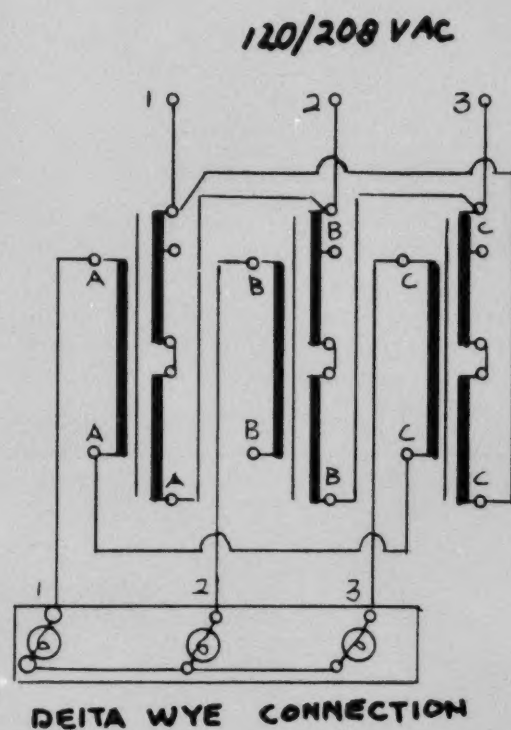
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. SAME AS J-3-22.
2. Refer to Table 1 on J-3-22.

METHOD OF EVALUATION:

The instructor will check the recorded voltages in table #1.



237

SCALE:		APPROVED BY:	DRAWN BY:
DATE:			REVISED:
THREE SINGLE PHASE TRANSFORMERS - DELTA-WYE			
238			DRAWING NUMBER D-3-23

JOB: Install and Connect Three Single
Phase Transformers To Wye-Wye

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-24

COURSE: Electrical Occupations

DRAWING NO: D-3-24

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: 3 Demonstration Transformers
Demonstration 3Ø Transformer
A 3-Lamp Board

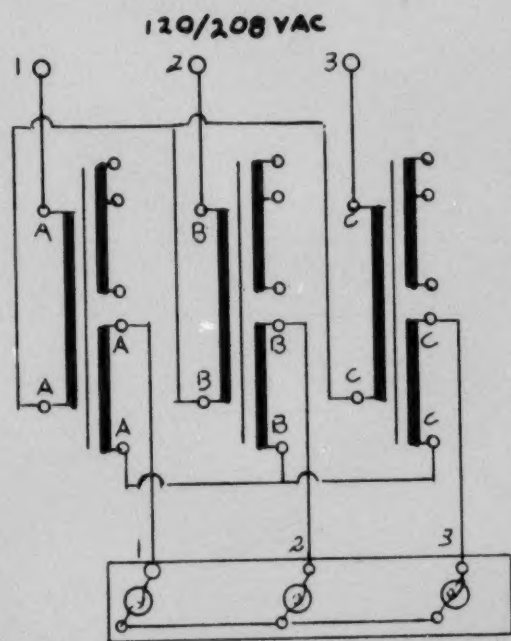
3 Lamps 40 Watt 120V
Input Control Unit

TOOLS: Standard Electrician's Tool Pouch

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	
1. SAME AS J-3-22.	
2. Refer to Table 1 on J-3-22.	

METHOD OF EVALUATION:

The instructor will check the recorded voltages on chart #1.



WYE - WYE CONNECTION

290

SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
THREE SINGLE PHASE TRANSFORMERS - WYE-WYE		
291		DRAWING NUMBER D-3-24

JOB: Install and Connect Three Single
Phase Transformers To Wye-Delta

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-25

COURSE: Electrical Occupations

DRAWING NO: D-3-25

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: 3 Demonstration Transformers
Demonstration 3Ø Transformer
A 3-Lamp Board

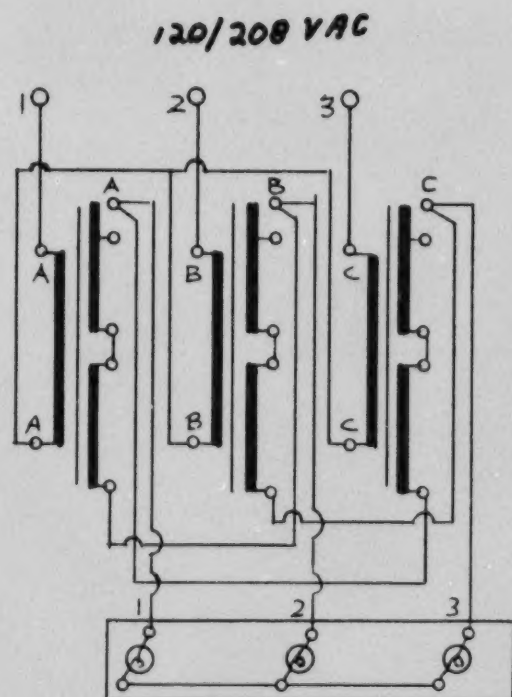
3 Lamps 40 Watt 120V
Input Control Unit

TOOLS: Standard Electricians Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. SAME AS J-3-22.	
2. Refer to Table 1 on J-3-22.	

METHOD OF EVALUATION:

The instructor will check the recorded voltages on Table #1.



WYE DELTA CONNECTION

203

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
THREE SINGLE PHASE TRANSFORMERS - WYE-DELTA		
294		DRAWING NUMBER D-3-25

JOB: Install and Connect Three Single
Phase Transformers to Open Delta

JOB SHEET
IDENTIFICATION CODE

UNIT III: Motor Generators

JOB NUMBER: J-3-26

COURSE: Electrical Occupations

DRAWING NO: D-3-26

MATERIAL: Escutcheon Plate
8 Patch Cords

EQUIPMENT: 3 Demonstration Transformers
Demonstration 3Ø Transformer
A 3-Lamp Board

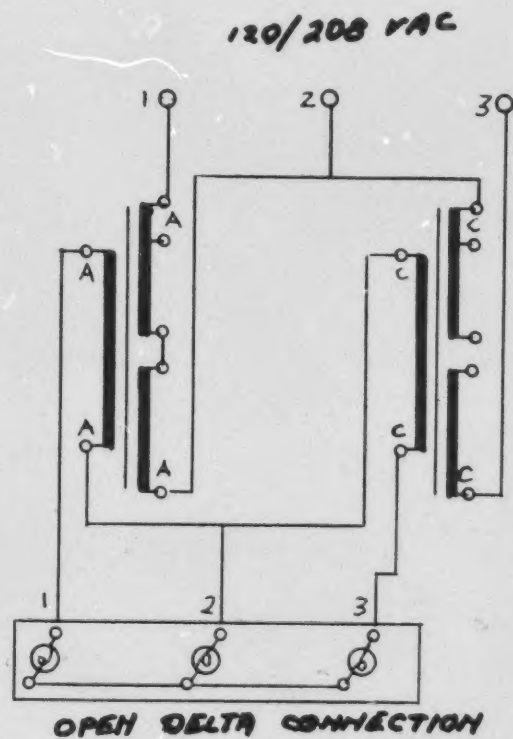
3 Lamps 40 Watt 120V
Input Control Unit

TOOLS: Standard Electrician's Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. SAME AS J-3-22.	
2. Refer to Table 1 on J-3-22.	

METHOD OF EVALUATION:

The instructor will check the recorded voltages on table #1.



SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
		DRAWING NUMBER
		D-3-26

JOB: Draw Various Equipment, Symbols
and Diagrams Used In Motor Control
Circuits

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-1

COURSE: Electrical Occupations

DRAWING NO: D-4-1a
D-4-1b

MATERIAL: Drawing of Symbols Paper
Drawing Equipment Pencil

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select the proper symbol to be drawn.	. SC-4-1
2. Neatly reproduce the symbol.	. SC-4-2

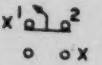
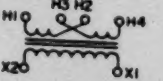
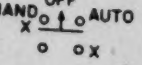
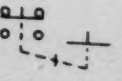
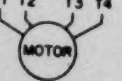
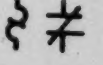
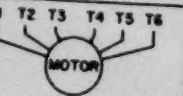
METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC Application
7. Local electric code application

OPERATING COILS		RELAY AND AUXILIARY CONTACTS	CONTACTOR AND STARTER POWER CONTACTS	TIMER CONTACTS
 MAIN OR LINE	 UNLATCH	 NORMALLY OPEN	 NORMALLY OPEN	 TIME DELAY OPENING Normally Closed
 FIRST MAIN	 FAST SPEED	 NORMALLY CLOSED	 NORMALLY CLOSED	 TIME DELAY CLOSING Normally Open
 SECOND MAIN OR DELTA	 SLOW SPEED			 TIME DELAY OPENING Normally Open
 START, SLOW, START OR STANDBY	 TORQUE			 TIME DELAY CLOSING Normally Closed
 RUN OR REVERSE	 CONTROL RELAY			
 FAST OR FORWARD	 TIMING RELAY			
 ACCELERATING	 JOG RELAY			
 NORMAL	 ACCELERATING RELAY			
 WYE				

wiring and schematic diagram symbols

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
WIRING AND SCHEMATIC DIAGRAM SYMBOLS		
		DRAWING NUMBER D-4-1a

SWITCHES	PUSH BUTTONS	MOTORS AND INDICATING LIGHTS	MISCELLANEOUS	TERMINAL BOARDS
 LIMIT Normally Open	 SINGLE CIRCUIT Normally Open	 INDICATING LIGHT Indicate color by letter symbol	 POWER OR CONTROL CIRCUIT FUSE	 POWER
 LIMIT Normally Closed	 SINGLE CIRCUIT Normally Closed	 THREE PHASE	 RESISTOR	 CONTROL
 PLUGGING	 DOUBLE CIRCUIT	 SINGLE PHASE Non-Reversing	 CONTROL TRANSFORMER Single Voltage	 JUMPER
 SELECTOR	 MUSHROOM HEAD	 SINGLE PHASE Reversing	 CONTROL TRANSFORMER Dual Voltage	
 HAND-OFF-AUTO	 MAINTAINED CONTACT	 TWO PHASE, FOUR WIRE	 OVERLOAD RELAY	
		 PART-WINDING		
		 WYE-DELTA		

wiring and schematic diagram symbols

SCALE:		APPROVED BY:		DRAWN BY	
DATE:				REVISED	
WIRING AND SCHEMATIC DIAGRAM SYMBOLS					
DRAWING NUMBER					D-4-1b

JOB: Draw Motor Control Circuits
Using Proper Symbols

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-2

COURSE: Electrical Occupations

MATERIAL: Drawing Sheets Paper
 Drawing Equipment Pencil

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Neatly draw various motor control circuits as instructed using the proper symbols.	. SC-4-1 . SC-4-2 . SC-4-4 . SC-4-6

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

JOB: Wire A Single Phase, Single
Station Motor Control System

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-3

COURSE: Electrical Occupations

DRAWING NO: D-4-3

MATERIAL: Wire Fuse-box
Relay Push-button
Motor Lampholder and Bulb

TOOLS: Shop Hand Tools

SAFETY PRECAUTIONS:

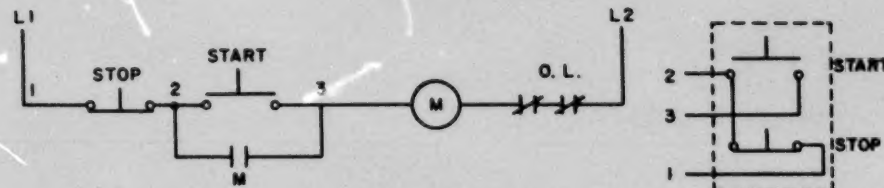
1. Practice all shop safety rules
2. Use caution with power-on circuit

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if necessary.	
8. Tear down job and store material.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Three-wire and Separate Controls



When the start button is pushed, the circuit is completed through the coil (M), and the contacts at M close. When the start button is released, the coil would be de-energized except for the holding contact at M. (Also called maintaining contact or sealing contact.) With the contact closed, the circuit is still complete through the coil. If the stop button is pushed, the circuit is broken, the coil loses its energy, and the contacts at M open. When the stop button is released, the circuit remains open because both the holding contact and the start button are open. The start button would have to be pushed again to complete the circuit. Operation of the overload would have the same effect. If the supply voltage failed, the circuit would be de-energized, and with a return of supply voltage the circuit would still remain open until the start button was pushed again. This is called no-voltage release and protects the operator and the equipment.

SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
SINGLE PHASE, SINGLE STATION MOTOR CONTROL SYSTEM		
		DRAWING NUMBER
		D-4-3

JOB: Wire a Single Phase, Hand-off-
auto Motor Control System

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-4

COURSE: Electrical Occupations

DRAWING NO: D-4-4

MATERIAL: Wire
Relay Hand-off-auto Switch
Fuse-box Motor Pressure Switch

TOOLS: Shop Hand Tools

SAFETY PRECAUTIONS:

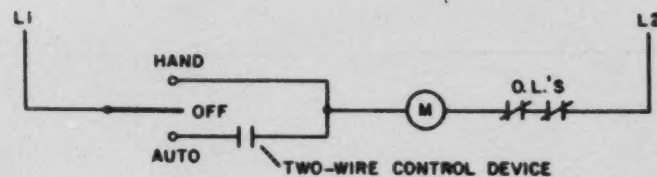
1. Practice all shop safety rules
2. Use caution with power on circuit

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if necessary.	
8. Tear down job and store material.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Hand-off Automatic Controls



In the hand position, the coil (M) is energized all the time, and the motor runs continuously. In the off position, the motor does not run at all. In the automatic position, the motor runs whenever the two-wire control device is closed. The control device may be a pressure switch, limit switch, thermostat, or other two-wire control.

SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
SINGLE PHASE, HAND-OFF-AUTO MOTOR CONTROL SYSTEM		
		DRAWING NUMBER
		D-4-4

JOB: Wire a Multiple Push-button
Station Motor Control System,
Single Phase

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-5

COURSE: Electrical Occupations

DRAWING NO.: D-4-5

MATERIAL: Wire
Relay Fuse Box
Motor 2 or More Push Buttons

TOOLS: Shop Hand Tools

SAFETY PRECAUTIONS:

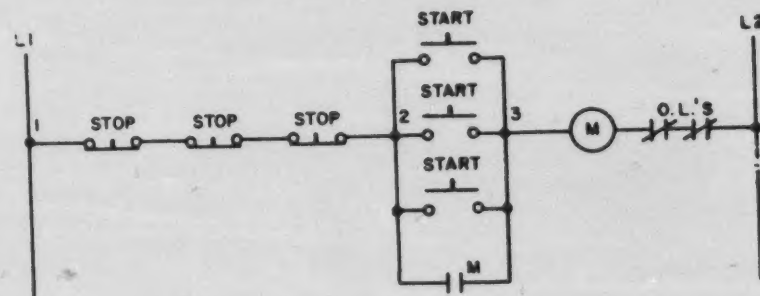
1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store materials.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Multiple Push Button Stations



When a motor must be started and stopped from more than one location, any number of start and stop buttons may be wired together as required. It is also possible to use only one "start-stop" station and have several stop buttons at different locations to serve as emergency stops.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
MULTIPLE PUSH-BUTTON STATION MOTOR CONTROL SYSTEM, SINGLE PHAS		
		DRAWING NUMBER
		D-4-5 312

JOB: Wire a Sequence (A or B) Control
Motor Control System, Single Phase

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-6

COURSE: Electrical Occupations

DRAWING NO: D-4-6A
D-4-6B

MATERIAL: Wire Fuse Box
Relays Push Buttons
Lights Time Delay Relays

TOOLS: Shop Hand Tools

SAFETY PRECAUTIONS:

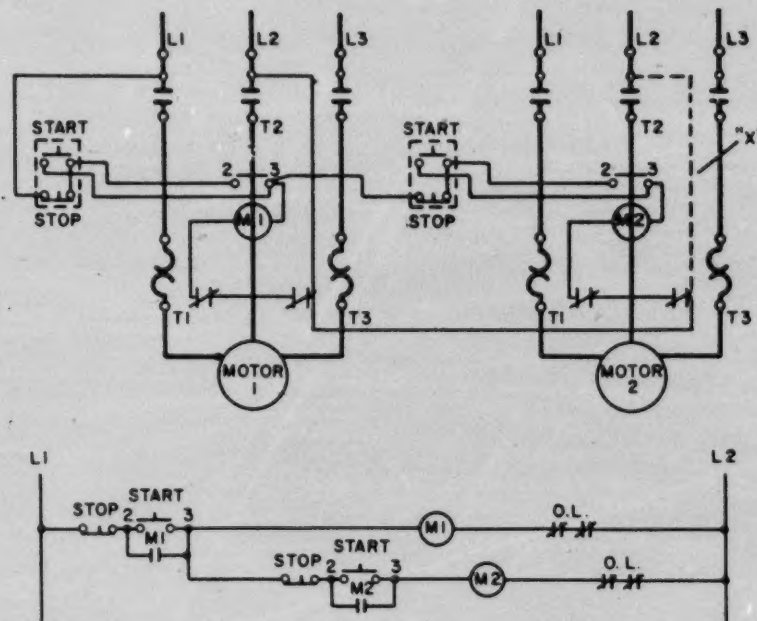
1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wire to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store material.	

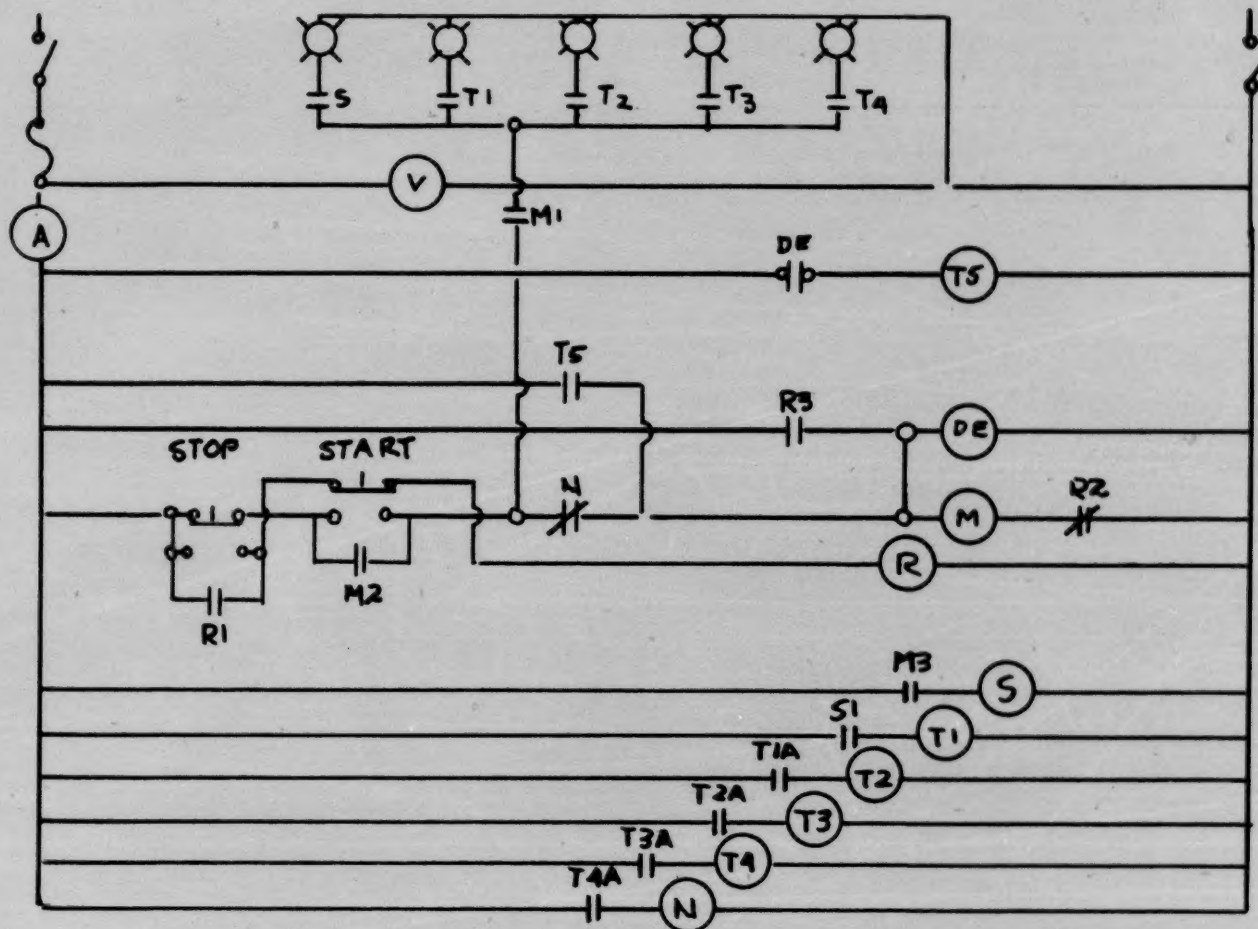
METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Sequence Control



SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
SEQUENCE (A OR B) CONTROL MOTOR CONTROL SYSTEM, SINGLE PHASE		
315		DRAWING NUMBER D-4-6A



MATERIALS

- 1 - STOP START PUSH BUTTON
- 6 - TIME RELAYS
- 4 - A.C. RELAYS
- 1 - A.C. AMMETER
- 1 - A.C. VOLTMETER

PROCEDURE: WIRE BOARD FOR SEQUENTIAL CONTROL OF LIGHTS

SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
PROCEDURE: Wire Board For Sequential Control Of Lights		
		DRAWING NUMBER
		D-4-6B

JOB: Wire a Time-Delay Low-Voltage
Release, Motor Control System,
Single Phase

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-7

COURSE: Electrical Occupations

DRAWING NO: D-4-7

MATERIAL: Time Delay Relays
Push Button Fuse Box Wire
Magnetic Starter Unit Motor

TOOLS: Shop Hand Tools

SAFETY PRECAUTIONS:

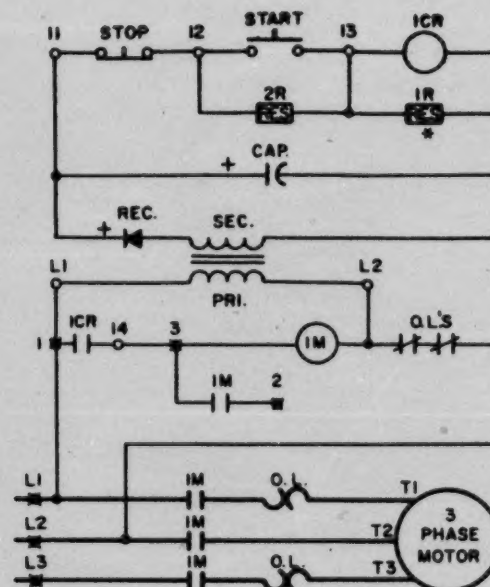
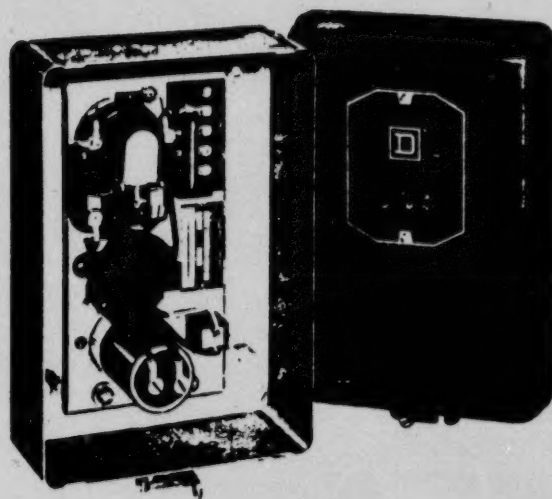
1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store material.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Time-delay, Low-voltage Release



X INDICATES TERMINALS ON MAGNETIC STARTER.
 * TO INCREASE TIME DELAY REMOVE RESISTOR 1R.
 O INDICATES TERMINALS ON TIME DELAY LOW VOLTAGE RELEASE.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
TIME-DELAY LOW-VOLTAGE RELEASE, MOTOR CONTROL SYSTEM, SINGLE PHASE		
		DRAWING NUMBER
		D-4-7

JOB: Wire Other Motor Control Systems,
Single Phase, Using:

- A. Timing Relays
- B. Pressure Switches
- C. Float Switches
- D. Limit Switches
- E. Solenoid Valves
- F. Temperature Switches

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-8

DRAWING NO: D-4-8A-F

UNIT IV: Motor Control

COURSE: Electrical Occupations

MATERIAL: As the shop material supply dictates

TOOLS: Shop Hand Tools

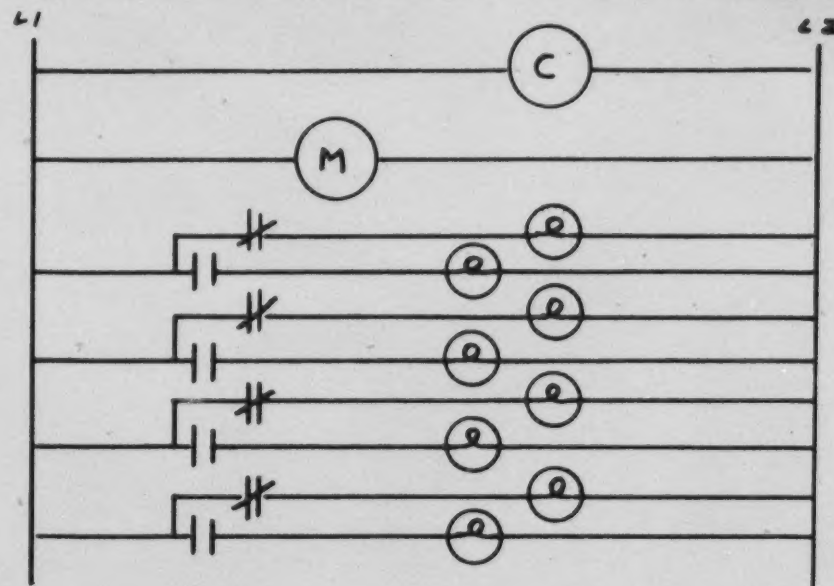
SAFETY PRECAUTIONS:

- 1. Practice all shop safety rules.
- 2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store material.	

METHOD OF EVALUATION:

- 1. Layout
- 2. Measurements
- 3. Splices and eyes
- 4. Print
- 5. Workmanship
- 6. NEC application
- 7. Local electric code application

**MATERIALS**

1- MOTOR TIMING RELAY
 8- LAMP HOLDERS
 8- LIGHT BULBS
 1- SWITCH BOX

TOOLS

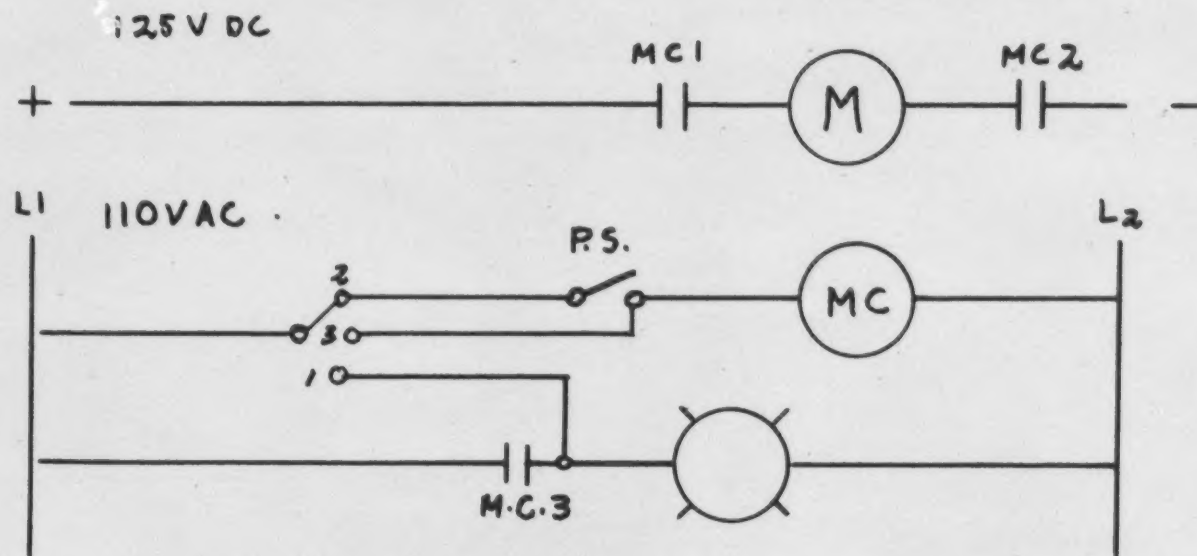
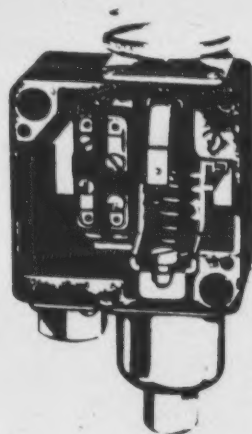
DIKES
 SIDE CUTTER
 KNIFE
 SCREW DRIVER
 NEEDLE NOSE PLIER

PROCEDURE.

WIRE THE LAMP HOLDERS TO BE OPERATED BY THE MOTORIZED TIMER. THE LIGHTS WILL BLINK OFF AND ON IN A SEQUENCE THAT WILL BE DETERMINED BY THE STUDENT.

SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
MOTOR CONTROL SYSTEM, SINGLE PHASE - TIMING RELAYS		
		DRAWING NUMBER
		D-4-8A

Pressure Switches and Regulators



MATERIALS
 RELAY
 SELECTOR SWITCH
 WIRE
 2 FUSE BOXES

PRESSURE SWITCH
 LAMP HOLDER
 LIGHT BULB
 MOTOR

TOOLS
 KNIFE
 DIKES
 SCREWDRIVER
 NEEDLE NSE
 SIDE CUTTER

PROCEDURE

CONNECT A SELECTOR SWITCH AND A PRESSURE SWITCH (TOGGLE SWITCH) TO OPERATE 110 V 60 CY. RELAY AND A 125 VOLT DC. MOTOR. WIRE IN INDICATING LIGHT TO BE ON WHEN MOTOR IS RUNNING.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
MOTOR CONTROL SYSTEM, SINGLE PHASE - PRESSURE SWITCHES		
		DRAWING NUMBER
		D-4-88

Float Switches



Float switches are designed and used for automatic control of a-c and d-c pump motor magnetic starters or for automatic direct control of light motor loads.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
MOTOR CONTROL SYSTEM, SINGLE PHASE - FLOAT SWITCH		
		DRAWING NUMBER D-4-8C

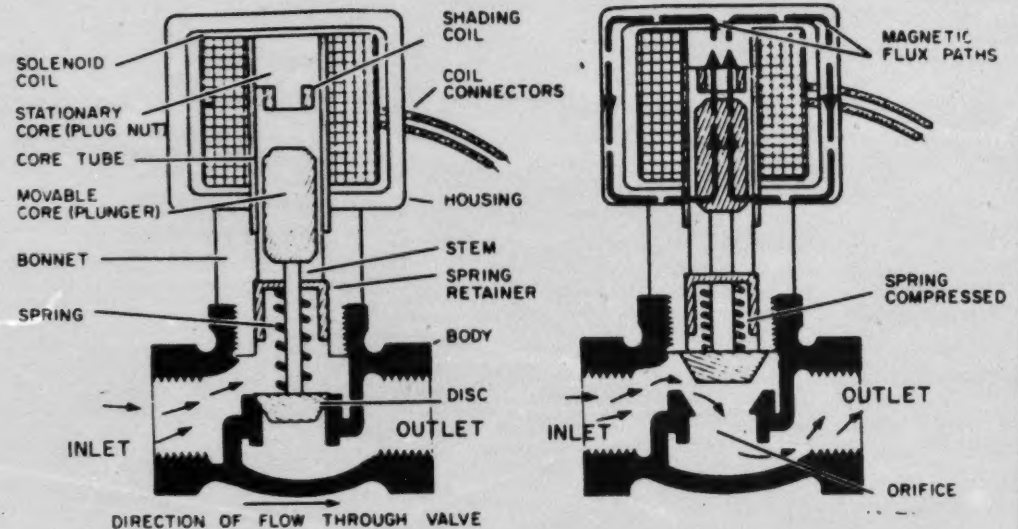
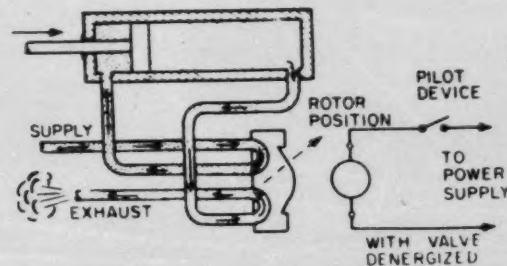
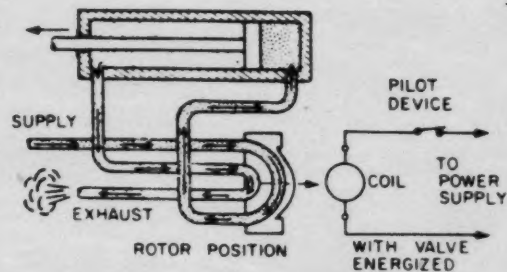
Limit Switches



Limit switches are ordinarily used as pilot devices in control circuits of magnetic starters to govern starting, stopping, or reversing of electric motors. They may be used either as control devices for regular operation or as emergency switches to prevent improper functioning of machinery.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
MOTOR CONTROL SYSTEM, SINGLE PHASE - LIMIT SWITCHES		
		DRAWING NUMBER
		D-4-8D

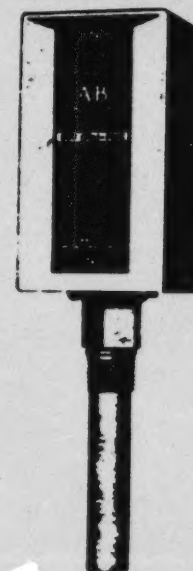
Solenoid Valves



Valves are mechanical devices designed to control the flow of fluids, such as air, oil, water, gases, etc. While many valves are manually operated, the trend for many years in modern industrial plants has been toward the use of electrically operated valves placed close to the devices they operate, thus keeping the necessary piping short. Remote control is then available, either by a manually operated switch or through the contacts of automatic electrical devices, by running only a pair of control wires between the valve and the control device.

SCALE:			APPROVED BY:			DRAWN BY		
DATE:						REVISED		
MOTOR CONTROL SYSTEM, SINGLE PHASE - SOLENOID VALVES								
						DRAWING NUMBER		
						D-4-8E		

Temperature Switches



Temperature switches are designed for automatic control of temperature maintaining equipment. General industrial temperature controllers are recommended for heating applications where the temperature to be controlled is higher than the normal or ambient temperature. In general, the application would be in connection with the controlled liquids rather than gases because of the relatively greater conductivity between bulb and liquid when compared to conductivity between bulb and gas (i. e., air, etc.). Generally, where air or gas temperature is to be controlled, the sensitivity will decrease and the difference between "on and off" will widen.

SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
MOTOR CONTROL SYSTEM, SINGLE PHASE - TEMPERATURE SWITCHES		
		DRAWING NUMBER D-4-8F

JOB: Wire a Motor Controller for A Two-Speed Two-Winding Motor, Three Phase

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-9

COURSE: Electrical Occupations

DRAWING NO: D-4-9

MATERIAL: Wire Push Buttons
 Relay Fuse Box

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

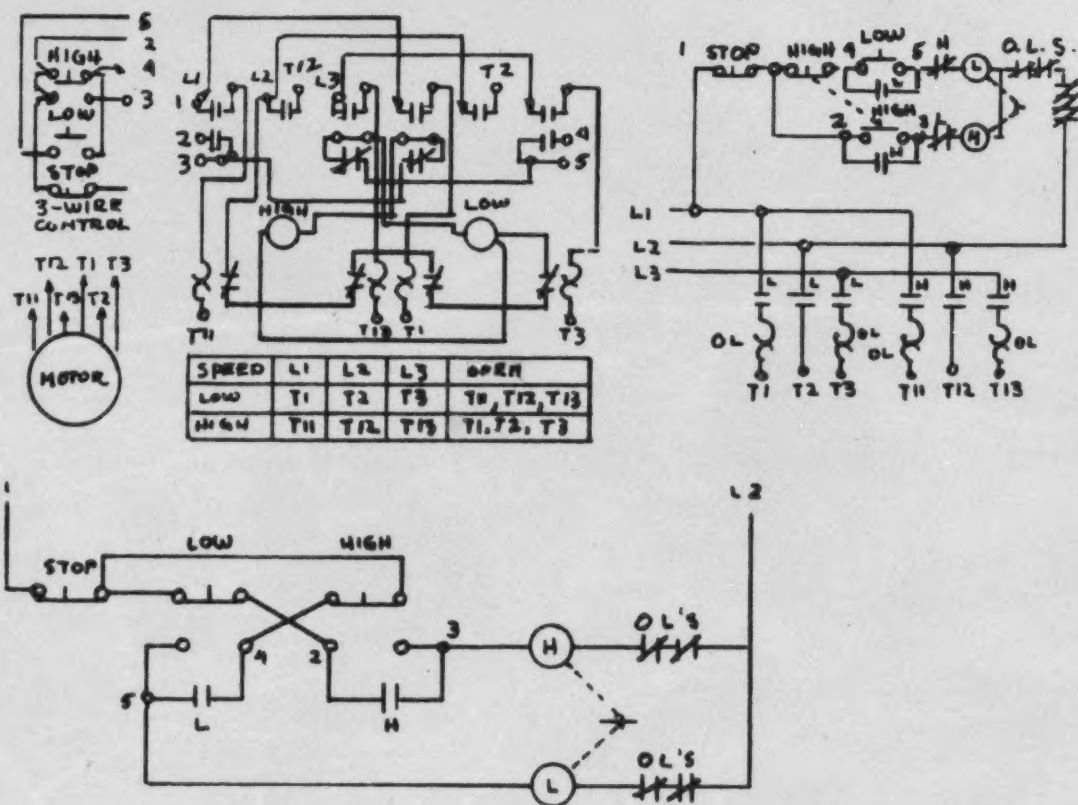
SAFETY PRECAUTIONS:

1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store material.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application



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SCALE:		APPROVED BY:	DRAWN BY:
DATE:			REVISED:
MOTOR CONTROLLER FOR A TWO-SPEED TWO-WINDING MOTOR, THREE PHASE			
			DRAWING NUMBER
			D-4-9

JOB: Wire a Two-Speed, One-Winding
Motor Controller, Three Phase

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-10

COURSE: Electrical Occupations

DRAWING NO: D-4-10

MATERIAL: Wire Push Buttons
 Proper Relay Fuse Box

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

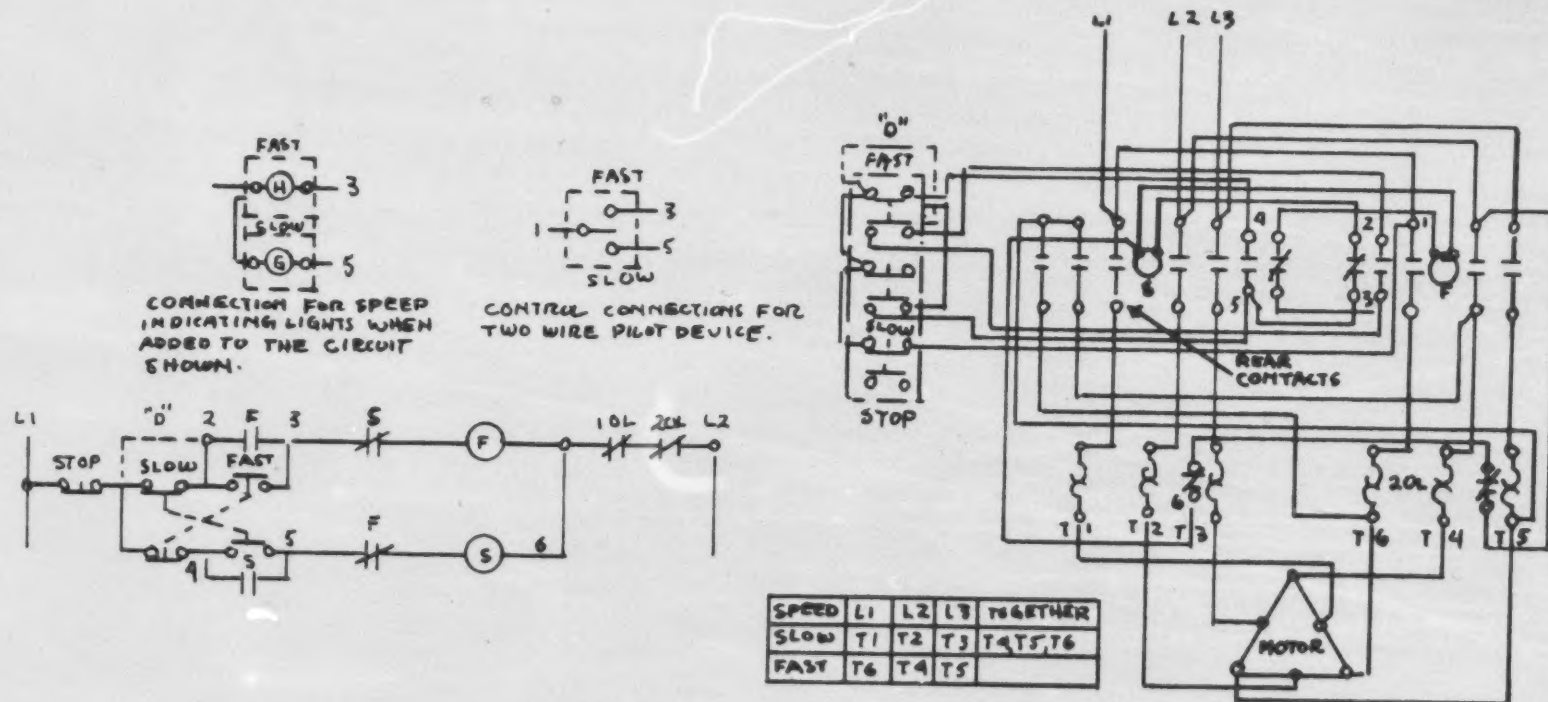
SAFETY PRECAUTIONS:

1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store material.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application



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SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
TWO-SPEED, ONE-WINDING MOTOR CONTROLLER, THREE PHASE		
		DRAWING NUMBER D-4-10

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JOB: Wire a Four-Speed, Two-Winding
Motor Controller, Three Phase

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-11

COURSE: Electrical Occupations

DRAWING NO: D-4-11

MATERIAL: Wire
Proper Relays
Proper Push Buttons

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

SAFETY PRECAUTIONS:

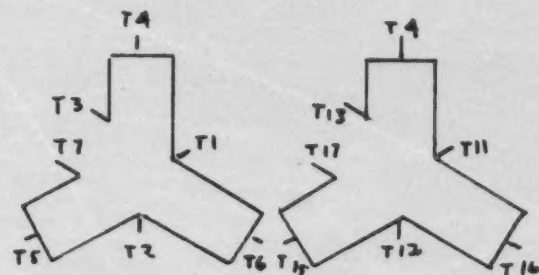
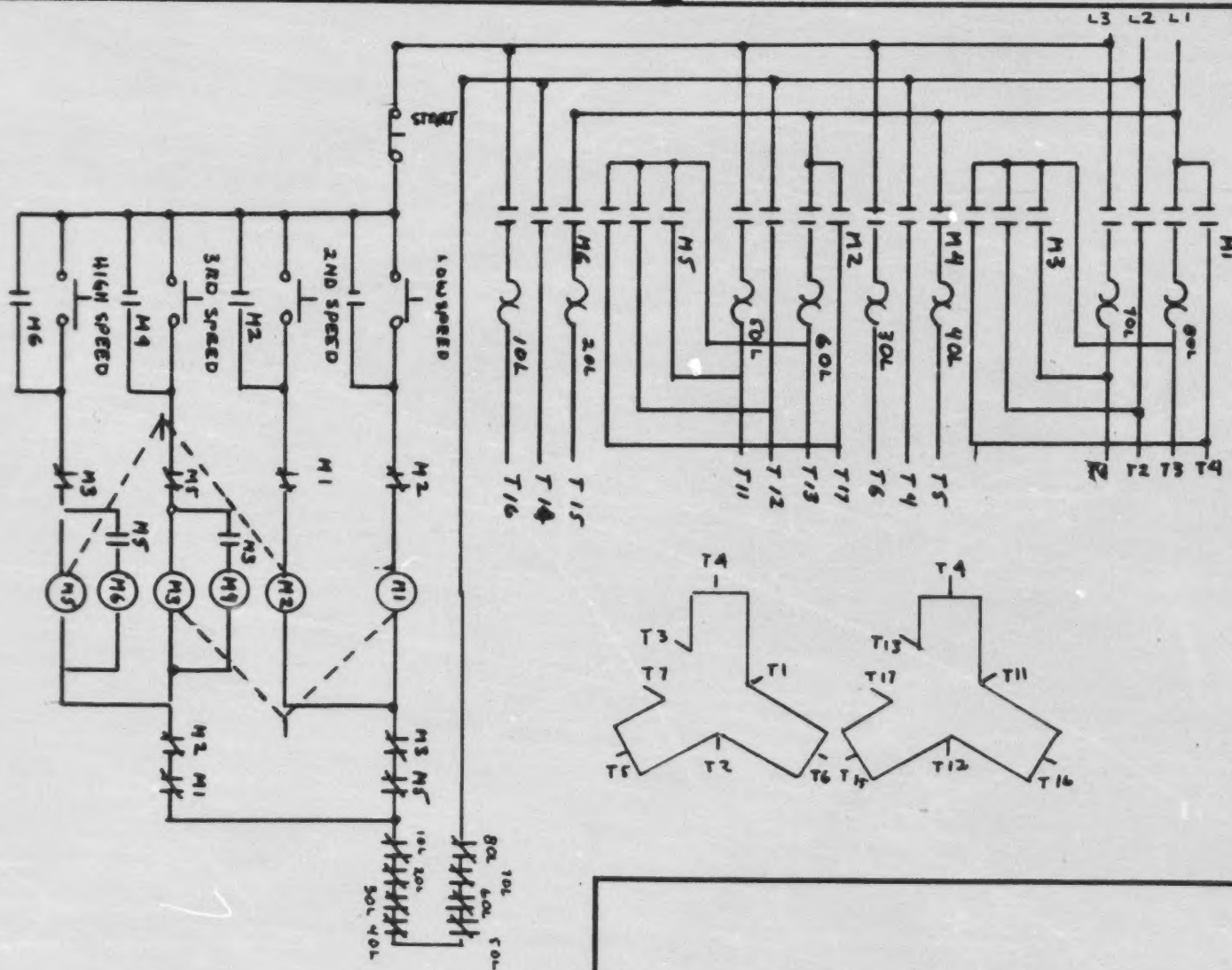
1. Practice all safety rules.
2. Use caution while power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for short and grounds.	
6. Apply voltage and test.	
7. Tear down job store material.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

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SPEED	L1	L2	L3	OPEN	TOGETHER
LOW	T1	T2	T3, T7	ALL OTHERS	
2ND	T11	T12	T13, T17	ALL OTHERS	
3RD	T6	T9	T5	ALL OTHERS	T1, T2, T3, T7
HIGH	T16	T14	T15	ALL OTHERS	T11, T12, T13, T17

SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED:
FOUR-SPEED, TWO-WINDING MOTOR CONTROLLER, THREE PHASE		
		DRAWING NUMBER
		D-4-11

JOB: Wire a Forward-Reverse Motor
Control System for Three Phase

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-12

COURSE: Electrical Occupations

DRAWING NO: D-4-12

MATERIAL: Wire Push Button
Proper Relay Limit Switches

TOOLS: One Set of Shop Hand Tools

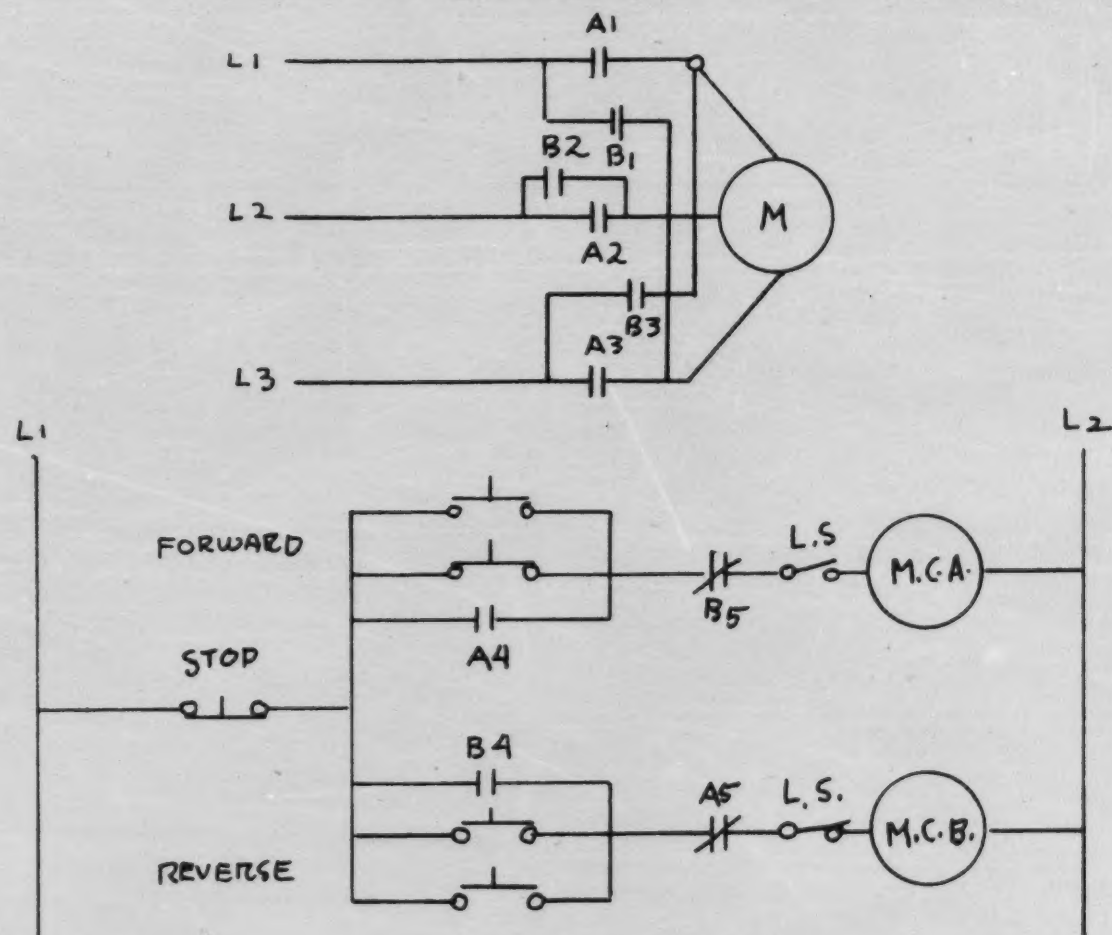
SAFETY PRECAUTIONS:

1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store material.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application



SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
FORWARD-REVERSE MOTOR CONTROL SYSTEM - THREE PHASE		
		DRAWING NUMBER
		D-4-12

JOB: Wire an Across-The-Line Starting
Controller for D.C.

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-13

COURSE: Electrical Occupations

DRAWING NO: D-4-13

MATERIAL: Wire Across The Line Starter Box
Fuse Box Stop and Start Push Button

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

SAFETY PRECAUTIONS:

1. Practice all shop safety rules.
2. Use caution when power is on.

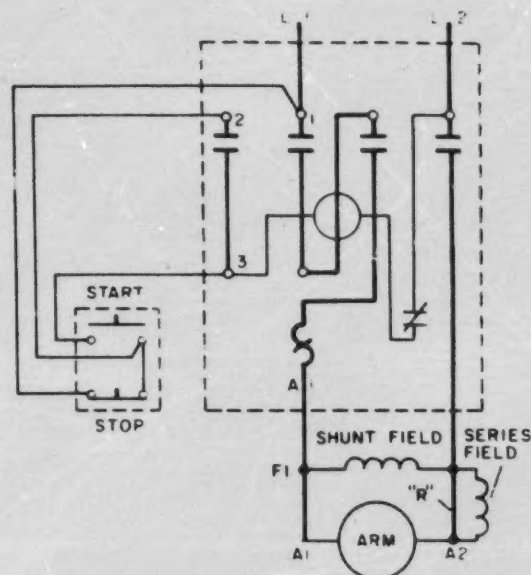
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and stop material.	

METHOD OF EVALUATION:

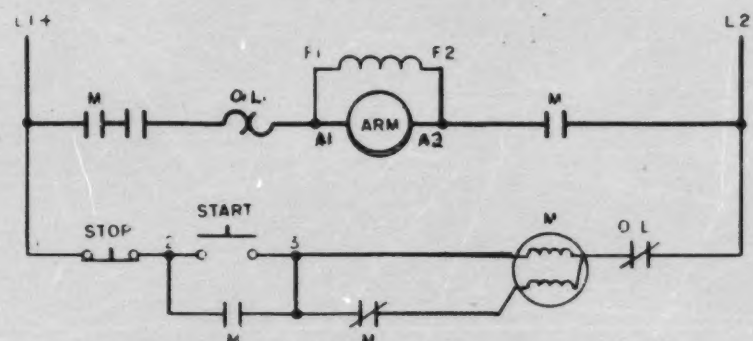
1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Across-the-line Starting

For starting small d-c motors, it is satisfactory to connect the motors directly across the line. This may be accomplished with the use of "fractional horsepower manual starters" or with magnetic contactors and starters.



D-c full voltage starter wiring diagram. Connection ("R") is removed with use of series field.



Line diagram of d-c motor starter with dual winding coil

431

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SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
ACROSS-THE-LINE STARTING CONTROLLER FOR D.C.		
		DRAWING NUMBER
		D-4-13 348

JOB: Wire a Magnetic Time Limit
Controller for D.C.

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-14

COURSE: Electrical Occupations

DRAWING NO: D-4-14

MATERIAL: Fuse Box Push Button
Wire Controller

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

SAFETY PRECAUTIONS:

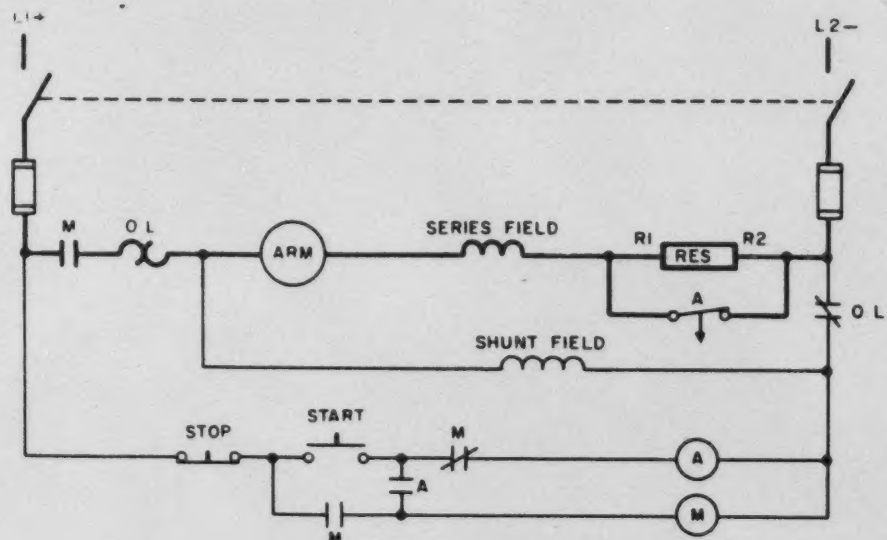
1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store material.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Magnetic Time Limit Controller



Line diagram of magnetic time limit starter.

The magnetic time limit controller operates on the principle of time delay by causing the magnetic flux of a coil to decay slowly. This is accomplished by means of a copper sleeve surrounding the iron core.

SCALE:	APPROVED BY:	DRAWN BY	
DATE:		REVISED	
MAGNETIC TIME LIMIT CONTROLLER FOR D.C.			
			DRAWING NUMBER D-4-14

JOB: Wire a Voltage-drop Acceleration
Controller for D.C.

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-15

COURSE: Electrical Occupations

DRAWING NO: D-4-15

MATERIAL: Fuse Box Controller
Wire Push Button

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

SAFETY PRECAUTIONS:

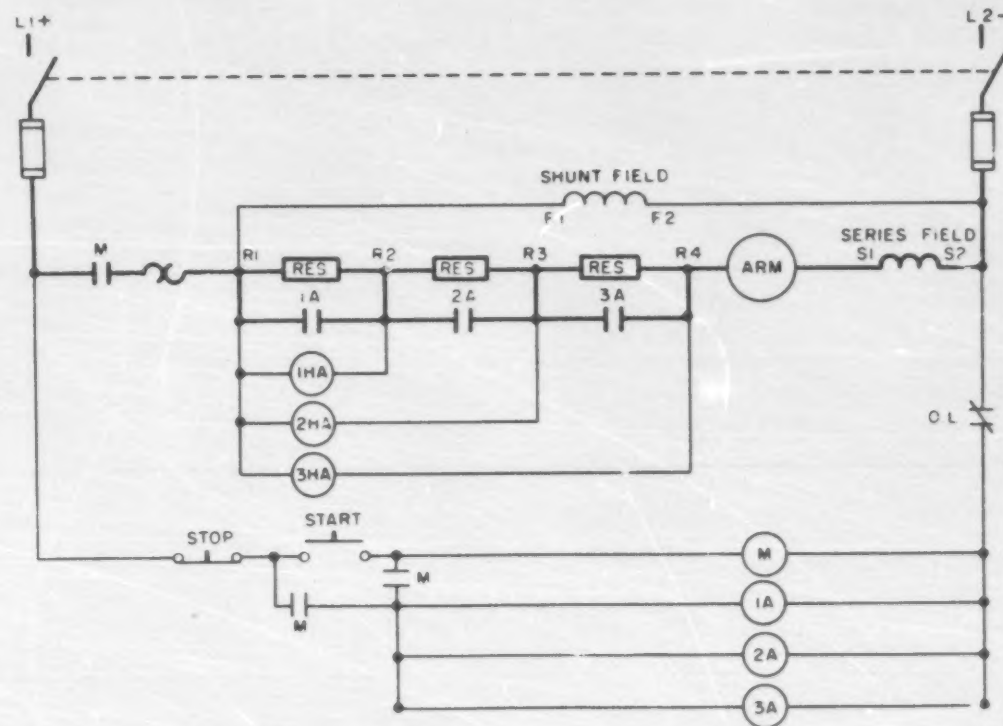
1. Practice all shop safety rules.
2. Be careful when using power on circuit.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all materials needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store materials.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Voltage Drop Acceleration



Voltage drop acceleration

Voltage drop acceleration refers to a d-c controller using double coil lockout contactors utilizing the voltage drop across the starting resistors to furnish current to the holding coils and obtain time delay.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
VOLTAGE-DROP ACCELERATION CONTROLLER FOR D.C.		
		DRAWING NUMBER
		D-4-15

JOB: Wire A Series Relay Acceleration
System for D.C.

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-16

COURSE: Electrical Occupations

DRAWING NO: D-4-16

MATERIAL: Wire
Relays Knife Switch
Resistors Stop - Start Push Button

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

SAFETY PRECAUTIONS:

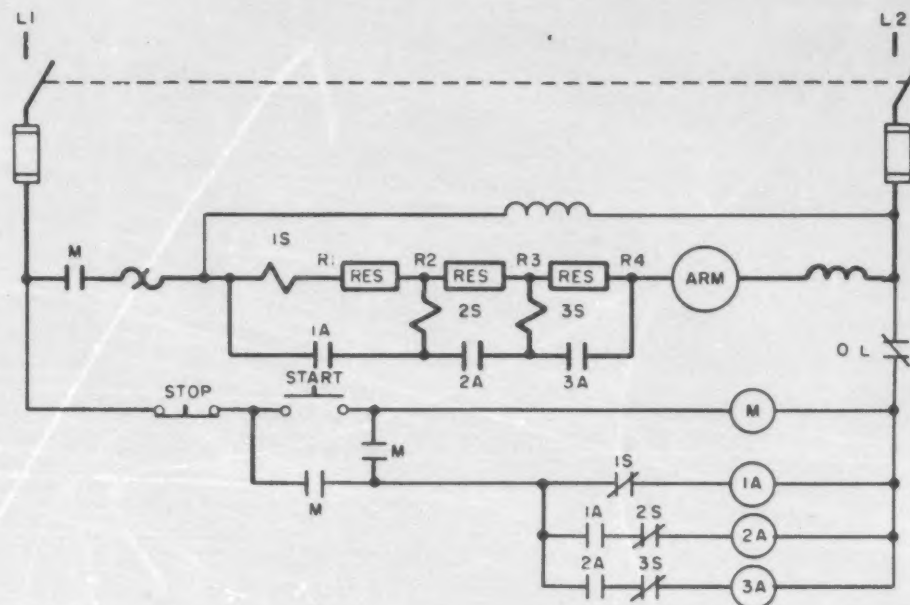
1. Use all shop safety precautions.
2. Be careful when power is on circuit.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all material.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for grounds and shorts.	
6. Apply proper voltage and test.	
7. Trouble-shoot job if needed.	
8. Tear down job and store material.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Series Relay Acceleration



Line diagram of d-c series relay acceleration.

Related Information

Series d-c relays consist of a few turns of heavy wire and are extremely fast in operation. A spring opens the contacts when the current decreases below the value for which the relay is set.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
SERIES RELAY ACCELERATION SYSTEM FOR D.C.		
		DRAWING NUMBER
		D-4-16

JOB: Install and Wire Other Control
Circuits of D.C. Control Using
Jog or Inch Control

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-17A

COURSE: Electrical Occupations

DRAWING NO: D-4-17A

MATERIAL: Wire Push Buttons
 Relays Fuse Box

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

SAFETY PRECAUTIONS:

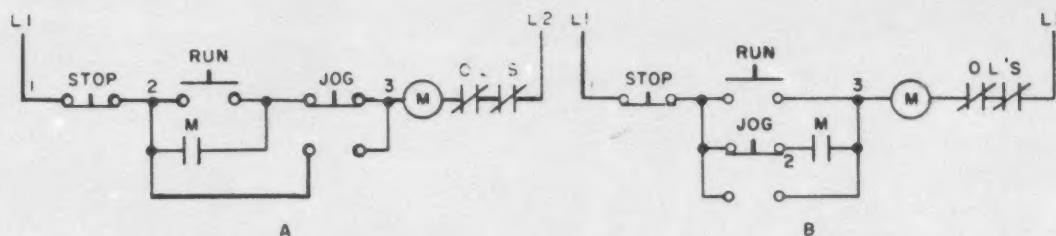
1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all materials needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store materials.	

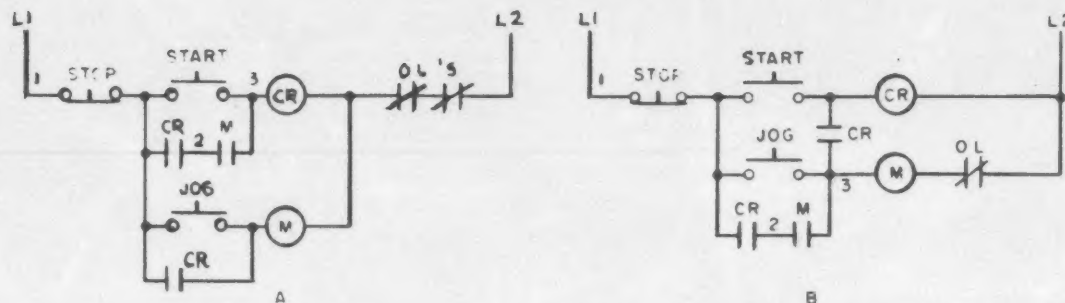
METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

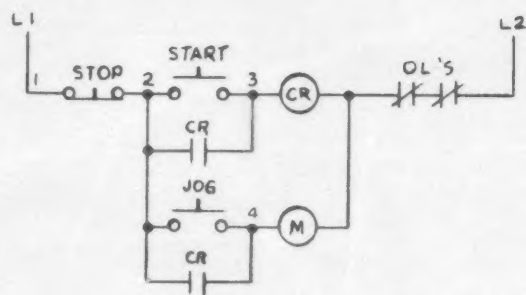
Jog or Inch



Line diagrams of simple jogging control schemes.



Line diagram using control relays in typical installations



Jogging is achieved with action of control relay.

SCALE:		APPROVED BY:	DRAWN BY
DATE:			REVISED
JOG OR INCH CONTROLS			
DRAWING NUMBER			D-4-17A

JOB: Install and Wire Other Control
Circuits of D.C. Control Using
Plugging Control

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-17B

COURSE: Electrical Occupations

DRAWING NO: D-4-17B

MATERIAL: Wire Push Buttons
 Relays Fuse Box

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

SAFETY PRECAUTIONS:

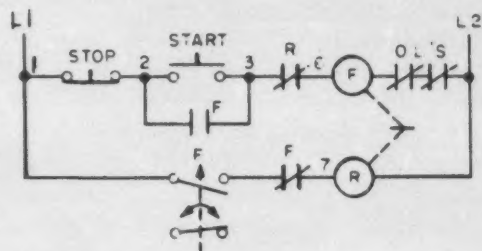
1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all materials needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store materials.	

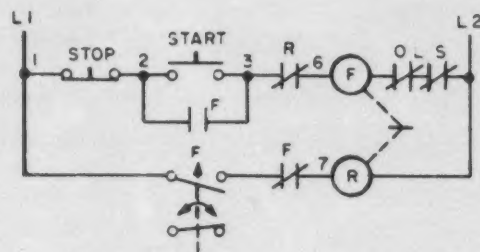
METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

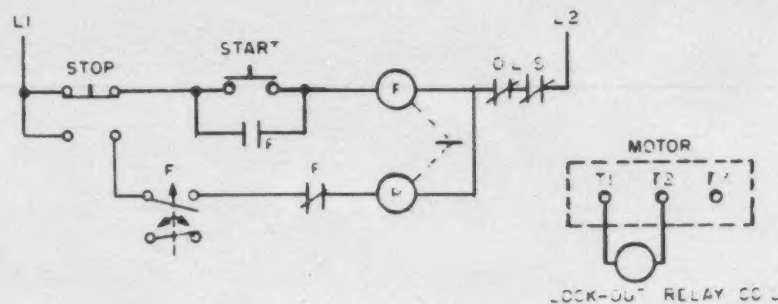
Plugging



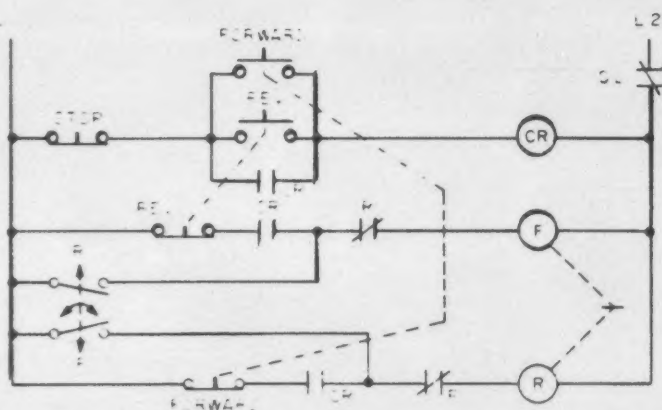
Plugging motor to stop from one direction only.



Plugging motor to stop from one direction only.



Holding stop button plug motor to stop in one direction.



Plugging motor to stop in either direction.

SCALE:		APPROVED BY:		DRAWN BY	
DATE:				REVISED	
PLUGGING CONTROL					
				DRAWING NUMBER	
				D-4-17B	

JOB: Install and Wire Other Control
Circuits of D.C. Control Using
Electric Braking Control

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-17C

COURSE: Electrical Occupations

DRAWING NO: D-4-17C

MATERIAL: Wire Push Buttons
 Relays Fuse Box

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

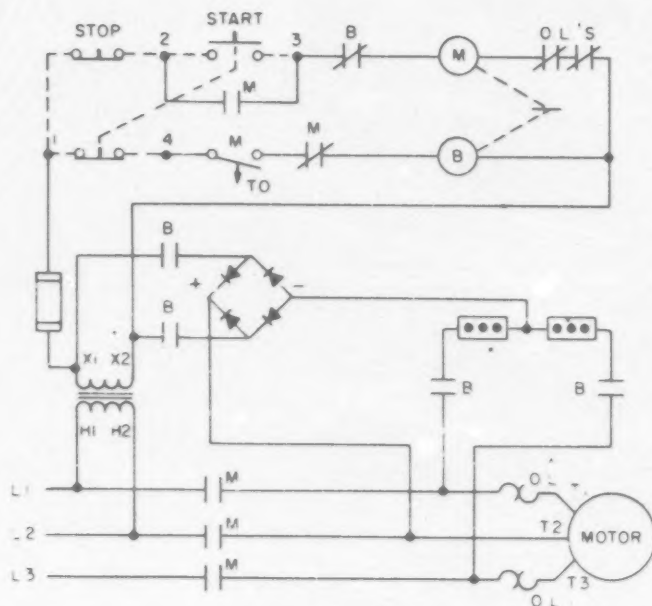
SAFETY PRECAUTIONS:

1. Practice all shop safety rules.
2. Use caution when power is on.

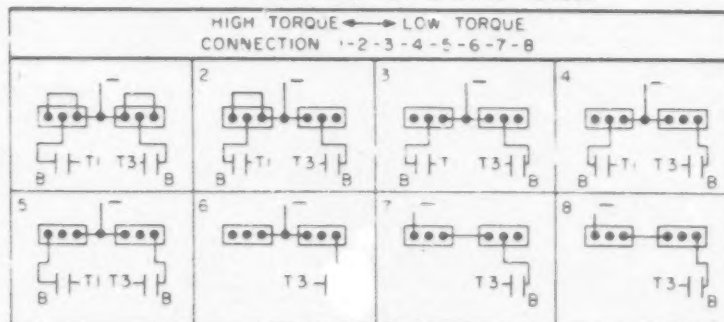
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all materials needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store materials.	

METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application



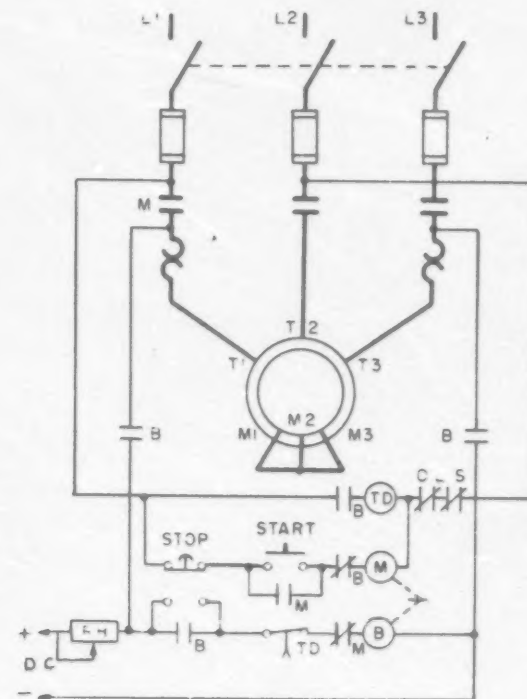
RESISTOR CONNECTIONS FOR BRAKING TORQUE



365

Typical line diagram of electric braking circuit.

Electric Braking



Line diagram of wound rotor motor with electric braking. Methods of starting and speed control are optional.

SCALE:		APPROVED BY:	DRAWN BY
DATE:			REVISED
ELECTRIC BRAKING CONTROL			
DRAWING NUMBER			D-4-17C

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JOB: Install and Wire Other Control
Circuits of D.C. Control Using
Dynamic Braking Control

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Motor Control

JOB NUMBER: J-4-17D

COURSE: Electrical Occupations

DRAWING NO: D-4-17D

MATERIAL: Wire Push Buttons
 Relays Fuse Box

EQUIPMENT: Motor

TOOLS: One Set of Shop Hand Tools

SAFETY PRECAUTIONS:

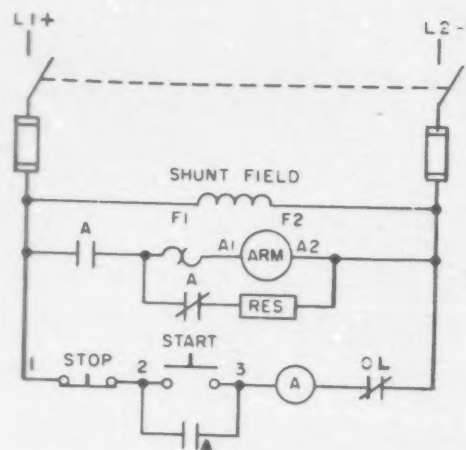
1. Practice all shop safety rules.
2. Use caution when power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select all materials needed.	. SC-4-1 through SC-4-11
2. Mount all equipment.	
3. Run all wires to equipment.	
4. Make all splices and connections.	
5. Test for shorts and grounds.	
6. Apply proper voltage and test job.	
7. Trouble-shoot job if needed.	
8. Tear down job and store materials.	

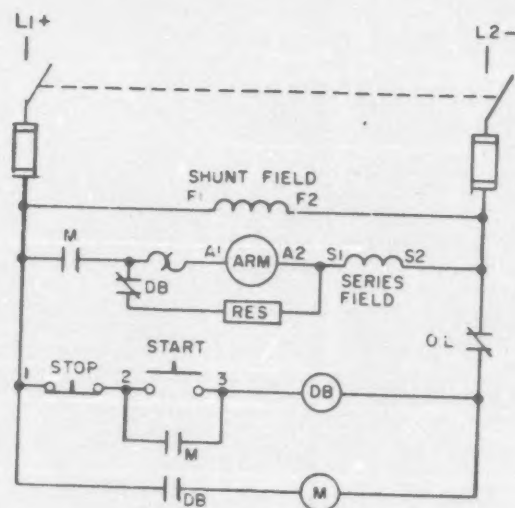
METHOD OF EVALUATION:

1. Layout
2. Measurements
3. Splices and eyes
4. Print
5. Workmanship
6. NEC application
7. Local electric code application

Dynamic Braking



Dynamic braking connections on motor starter



DC motor starter modified with dynamic braking.

368

SCALE:			APPROVED BY:			DRAWN BY		
DATE:						REVISED		
DYNAMIC BRAKING CONTROL								
							DRAWING NUMBER	
							D-4-17D	

369

JOB: Perform Maintenance on a Defective
Fluorescent Fixture

JOB SHEET
IDENTIFICATION CODE

UNIT V: Electrical Maintenance

JOB NUMBER: J-5-1

COURSE: Electrical Occupations

MATERIAL: Fluorescent lamps with several defects

EQUIPMENT: Cathode Voltage Indicator
Test Volt Meter
Tester for Recessed Double Contact and Bipin Sockets

TOOLS: Standard Electricians' Tool Pouch

SAFETY PRECAUTIONS:

1. Be careful of breakage.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Visually check fixtures.	
2. Plug in fixture.	
3. Check for faults.	
4. Make proper adjustments.	

METHOD OF EVALUATION:

The instructor will check fixture for proper operation.

JOB: Perform Periodic Maintenance on
a Motor

JOB SHEET
IDENTIFICATION CODE

UNIT V: Electrical Maintenance

JOB NUMBER: J-5-2

COURSE: Electrical Occupations

MATERIAL: A Large Rotating Motor/Generator

EQUIPMENT: Volt Ohmmeter
Meggar Pencil
Paper Pad

TOOLS: Standard Electricians' Tool Pouch

SAFETY PRECAUTIONS:

1. Be sure the electrical service is shut off.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Visual inspection.	
2. Check armature windings.	
3. Check field windings.	
4. Check brush riggings.	
5. Test the insulation resistance.	
6. Check for cleanness.	
7. Check voltage.	

METHOD OF EVALUATION:

The instructor will turn motor on to check for proper operation.

JOB: Perform Periodic Maintenance on
an Emergency Lighting System

JOB SHEET
IDENTIFICATION CODE

UNIT V: Electrical Maintenance

JOB NUMBER: J-5-3

COURSE: Electrical Occupations

MATERIAL: A small motor generator set, or
the school's large system

EQUIPMENT: Volt Ohmmeter

TOOLS: Standard Electricians' Tool Pouch

SAFETY PRECAUTIONS:

1. If using a gasoline engine have proper ventilation.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Visually check the fixtures.	
2. Check the chart for last inspection.	
3. Check readings.	
4. Turn system on.	
5. Check voltage/amperage.	
6. Write findings in the record chart.	

METHOD OF EVALUATION:

The instructor will check the chart.

JOB: Check and Perform Maintenance on
an Electrical Operated Overhead
Door

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-4

UNIT V: Electrical Maintenance

COURSE: Electrical Occupations

MATERIAL: Use the overhead doors in the
shop area

EQUIPMENT: Ladder

TOOLS: Standard Electricians' Tool Pouch

SAFETY PRECAUTIONS:

1. Have someone with you to steady ladder.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Visually check the equipment.	
2. Check on chart when last inspected and oiled.	
3. Check for loose track.	
4. Check the alignment of door.	
5. Inspect chain, belts, steel cables for fraying.	
6. Check motor.	
7. Check controls.	

METHOD OF EVALUATION:

The instructor will observe the work being done.

JOB: Perform Periodic Maintenance on
an Elevator

UNIT V: Electrical Maintenance

COURSE: Electrical Occupations

MATERIAL: A Small one or two Passenger
Elevator or a Chair Rise on Steps

EQUIPMENT: Volt Ohmmeter

TOOLS: Standard Electricians' Tool Pouch

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-5

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Visually check the equipment.	
2. Check the guide rails for alignment.	
3. Inspect cable for fraying.	
4. Check the safety devices, door closer bottom device etc.	
5. Check controls.	
6. Check pulleys.	
7. Check motor.	
8. Adjust and record findings in service chart.	

METHOD OF EVALUATION:

The instructor will check the chart.

JOB: Perform Maintenance on a Control
Unit of an Electric Sign

JOB SHEET
IDENTIFICATION CODE

UNIT V: Electrical Maintenance

JOB NUMBER: J-5-6

COURSE: Electrical Occupations

MATERIAL: The Control Unit
Contact Cleaner Contact Lubrication

EQUIPMENT: Voltmeter
Ohmmeter

TOOLS: Standard Electricians' Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Visually check the control.	
2. Check contacts for worn parts.	
3. Check gears.	
4. Check lites.	
5. Mark on chart the date and what was done.	

METHOD OF EVALUATION:

The instructor will check the chart.

JOB: Perform Maintenance on an Emergency
Lighting System (Batt.)

JOB SHEET
IDENTIFICATION CODE

UNIT V: Electrical Maintenance

JOB NUMBER: J-5-7

COURSE: Electrical Occupations

MATERIAL: Emergency Battery System

EQUIPMENT: Volt Ohmmeter
Hydrometer

TOOLS: Standard Electricians' Tool Pouch

SAFETY PRECAUTIONS:

1. Watch out for battery acid.
2. Wear goggles.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Visually inspect the unit.	
2. Check the battery for specific gravity.	
3. Check the change over switch.	
4. Check the lamps.	
5. Test unit.	
6. Mark chart.	

METHOD OF EVALUATION:

The instructor will test the unit and check the service chart.

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JOB: Perform Maintenance on an Escalator

JOB SHEET
IDENTIFICATION CODE

UNIT V: Electrical Maintenance

JOB NUMBER: J-5-8

COURSE: Electrical Occupations

MATERIAL: An Escalator

EQUIPMENT: Voltmeter
Ohmmeter Megger Lubricant

TOOLS: Standard Electricians' Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Be sure switch is locked in the off position. 2. Visually check the track. 3. Visually check the steps. 4. Check the motor. 5. Check the emergency stop control. 6. Mark service chart.	NOTE: Watch for loose links.

METHOD OF EVALUATION:

The instructor will check the operation of the unit and the chart.

JOB: Perform Maintenance on Various
Lighting Systems

JOB SHEET
IDENTIFICATION CODE

UNIT V: Electrical Maintenance

JOB NUMBER: J-5-9

COURSE: Electrical Occupations

MATERIAL: Use the School's System

EQUIPMENT: Voltmeter Drawing of the Building
 Inspection Chart Light Meter to check the Candle Power

TOOLS: Standard Electricians' Tool Pouch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check the main service.	
2. Check stairwells.	
3. Check halls.	
4. Check the emergency lighting system.	
5. Check the exit lights.	
6. Check each room.	
7. Record on chart.	

METHOD OF EVALUATION:

The instructor will check the completed chart.

JOB: Perform Maintenance on an
Electrical Furnace (Induction)

JOB SHEET
IDENTIFICATION CODE

UNIT V: Electrical Maintenance

JOB NUMBER: J-5-10

COURSE: Electrical Occupations

MATERIAL: Furnace with Electrical Problem

EQUIPMENT: Volt - Ohmmeter

TOOLS: Standard Electricians' Tool Pouch

SAFETY PRECAUTIONS:

1. Use all safety precautions while power is on.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Give furnace a visual check.	
2. Check name plate data.	
3. Check wiring diagram.	
4. Make proper test using meter.	
5. Make diagnosis of trouble.	
6. Repair faulty area.	

METHOD OF EVALUATION:

The instructor will test the repaired furnace.

JOB: Perform Maintenance on an
Electric Furnace (Dielectric)

JOB SHEET
IDENTIFICATION CODE

UNIT V: Electrical Maintenance

JOB NUMBER: J-5-11

COURSE: Electrical Occupations

MATERIAL: Furnace with a problem

EQUIPMENT: Volt - Ohmmeter

TOOLS: Standard Electricians' Tool Pouch

SAFETY PRECAUTIONS:

1. Use all safety precautions.
2. Wear proper dress.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Give furnace a visual check.	
2. Check name plate data.	
3. Check wiring diagram of furnace.	
4. Make proper test using meter.	
5. Make diagnosis of trouble.	
6. Repair faulty area.	

METHOD OF EVALUATION:

The instructor will test the operation of the repaired unit.

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JOB: Troubleshoot and Repair a Faulty
Hot Water Heater

UNIT V: Electrical Maintenance

COURSE: Electrical Occupations

MATERIAL: Hot Water Heater with some Faults

EQUIPMENT: Volt - Ohmmeter

TOOLS: Standard Electricians' Tool Pouch

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-12

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Visually check the equipment.	
2. Check name plate.	
3. Check for voltage.	
4. Check for dual operating thermometers.	NOTE: Turn power off. Disconnect wires on units.
5. Check units.	
6. Check for leaks.	

METHOD OF EVALUATION:

The instructor will test the finished work.

JOB: Develop a Complete Maintenance Program with Individual Reports for each Machine and other Electrical Devices Used within The School

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-13

UNIT V: Electrical Maintenance

COURSE: Electrical Occupations

MATERIAL: All The Electrical Equipment within The School Building

EQUIPMENT: Pad
Pencil
Flashlight

TOOLS: A publication "Successful Electrical Maintenance"
Published by McGraw-Hill, Inc.

SAFETY PRECAUTIONS:

1. Wear safety glasses.
2. Wear a hard hat.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Make a complete list of all the electrical equipment within the building.	
2. Record each area.	
3. Place on a card index or master sheet.	
4. Determine maintenance priority.	
5. Select the best maintenance techniques.	

METHOD OF EVALUATION:

The instructor will go over the finished program with the student.

COMPETENCY: Cut Wire

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To cut the wire to the proper length acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

1. Pick up the side cutters.



2. Open the cutters by pushing the bottom handle with your little finger and letting your other three fingers open at the same time.



3. Put the cutting jaws over the wire and squeeze the cutters until you can feel pressure on the wire.



4. Keep pressure on the wire and move your little finger to the outside of the handle. Squeeze the cutters until the wire cuts off.



METHOD OF EVALUATION:

The instructor will observe work in progress.

COMPETENCY: Strip a Conductor with a Knife

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To remove the insulation acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

1. Hold the insulated wire in one hand and the knife in the other. Place the knife blade about $1\frac{1}{4}$ " from the end of the wire.
2. Push the knife forward carefully so you do not nick the conductor.

CAUTION: Never cut toward yourself when using a knife. Always turn the blade away from yourself.



3. Rotate the wire and repeat Step 2 until all the insulation is removed.



METHOD OF EVALUATION:

The instructor will observe the student's procedure.

COMPETENCY: Strip Wire with Wire Strippers

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To strip the wire to the proper length acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place wire stripper in right hand holding as shown.	
2. Open cutter by pushing bottom handle with little finger and letting other three fingers open at the same time.	
3. Place wire in proper hold with left hand. (#14 wire in #14 hole, #12 wire in #12 hole, etc.)	
4. Squeeze stripper until you feel the insulation start to cut.	
5. Keep pressure on wire and wrap little finger around handle. Squeeze stripper shut.	

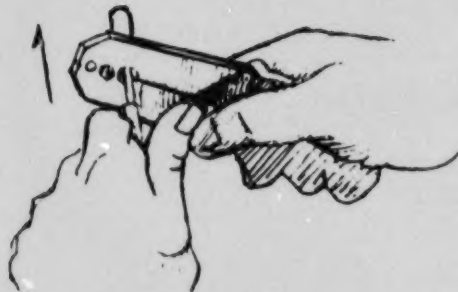
COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

6. Hold wire tightly with fingers and place left thumb on side of stripper.



7. Push stripper with thumb and pull wire with fingers.



METHOD OF EVALUATION:

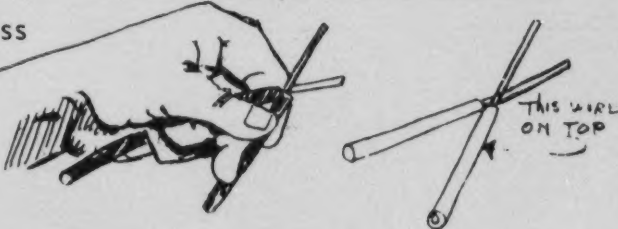
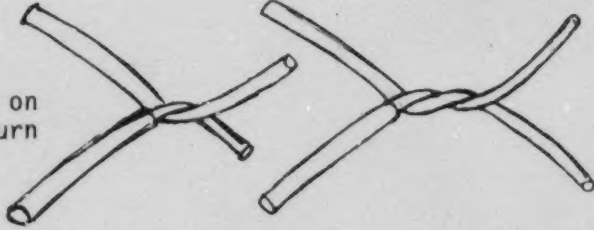
The instructor will observe the student's technique.

COMPETENCY: Twist a Tap (2 Wire)

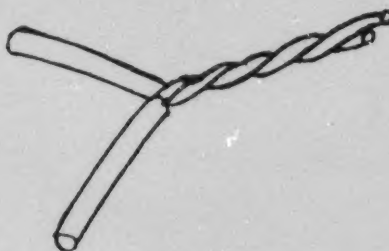
COURSE: Electrical Occupations

UNIT II: Wiring Methods

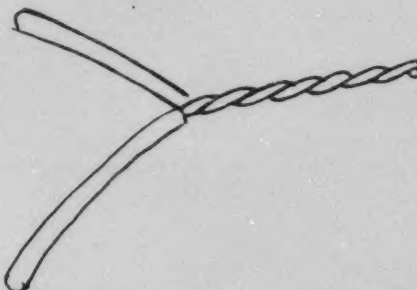
OBJECTIVE: To twist 2 wire taps acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold both wires in one hand and cross them about $\frac{1}{4}$ " from the insulation.	
2. Push the wires with your index finger and bend them slightly.	
3. Place the wires between the jaws of pliers and turn them with the pliers $\frac{1}{4}$ turn clockwise. Only the bare wires should twist. Squeezing the pliers too tightly will make the insulated part of the wire twist.	
4. Remove the pliers and place them back on the wires about $\frac{1}{2}$ " from the twist. Turn them a full turn clockwise.	

5. Repeat step 4 until the wires are completely twisted together.



6. If the wires are uneven, use the side cutter to snip off any excess and make them even.



METHOD OF EVALUATION:

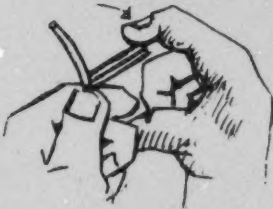
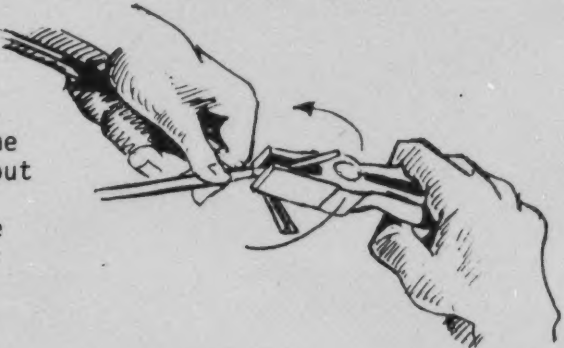
Student's work will be observed by the instructor.

COMPETENCY: Twist a Three Wire Tap

COURSE: Electrical Occupations

UNIT II: Wiring Methods

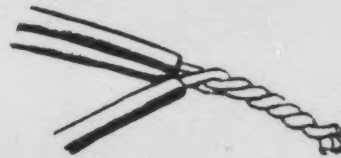
OBJECTIVE: To twist 3-wire taps acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the wires crossed in one hand and make sure the insulation on all three is even. Squeeze the wires very tightly between your thumb and index finger.	
2. With the other index finger, bend the wires slightly by pushing them.	
3. Place the wires between the jaws of the side cutter. The jaws should hold about 1/4" from the cross. Turn the cutters about 1/4 turn clockwise. Squeezing the cutters too tightly will cause the insulation to twist.	
4. Remove the cutters and replace them on the wires about 1/2" from the twist and twist a full turn clockwise.	

5. Repeat step 4 until the wires are completely twisted together.



6. If the ends of the wires are uneven, snip off the long ones with the side cutters so that all three are even.



METHOD OF EVALUATION:

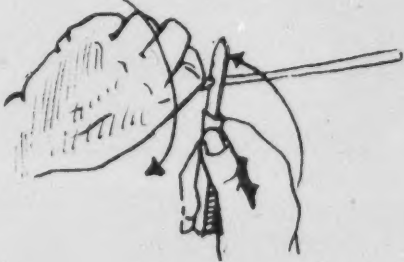
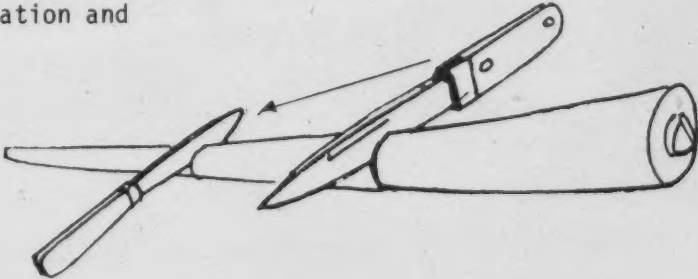
The instructor will observe the finished work.

COMPETENCY: Remove Insulation Leaving a Lead

COURSE: Electrical Occupations

UNIT II: Wiring Methods

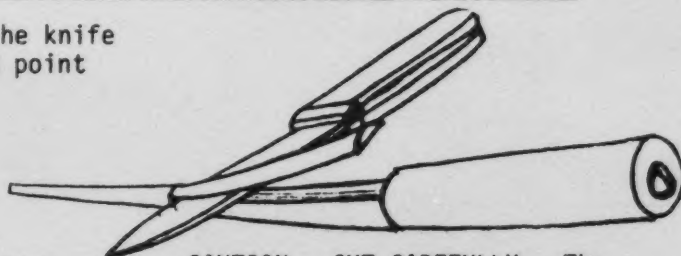
OBJECTIVE: To remove part of the insulation leaving a lead acceptable to the standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the knife in one hand and the wire in the other.	
2. Hold the knife against the wire and push gently on the insulation by squeezing it with your thumb and index finger.	
3. Turn the knife clockwise and cut all the way around. Be careful to just cut the insulation and not the wire.	
4. Move up the insulation the distance that you want to remove the insulation and repeat steps 2 and 3.	

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

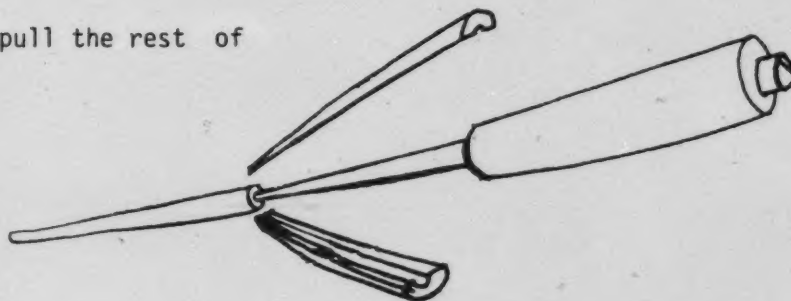
5. Hold the wire tightly and place the knife at a 45° angle to the wire at the point you cut the insulation.



6. Push the back of the blade with your thumb until you get to the other point that you cut around the insulation.

CAUTION: CUT CAREFULLY. The knife could easily slip and cut you.

7. Lay the knife down and pull the rest of the insulation off.



METHOD OF EVALUATION:

The instructor will observe the technique used.

COMPETENCY: Twist a Two Wire Tap with a Lead

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To twist 2-wire taps leaving a lead acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS

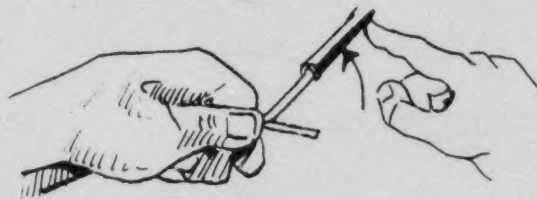
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Cross the wires and keep the insulation on both of them even. Squeeze them tightly between your thumb and index finger.



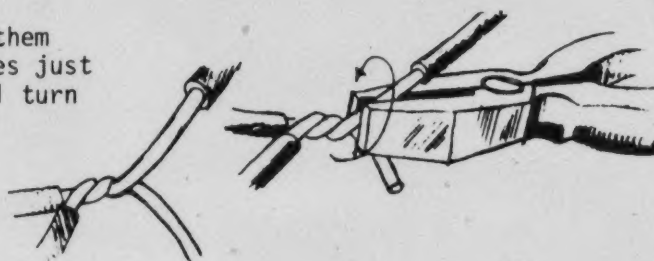
2. With the other index finger, push the wires to bend them slightly.



3. Place the jaws of the side cutters over both wires just above the cross and turn the wires clockwise about $\frac{1}{4}$ turn.



4. Remove the side cutters and turn them back. Place them back on the wires just above the twist. Turn them a full turn clockwise.



5. Repeat step 4 until the wires are twisted to the end.



6. If the insulation has slipped back on the wire, slide it back in place by putting one hand near the tap and pushing the insulation with the other hand.



METHOD OF EVALUATION:

The instructor will inspect the finished job.

COMPETENCY: Twist a Three-Wire Tap with a Lead

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To twist 3-wire taps leaving a lead acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS

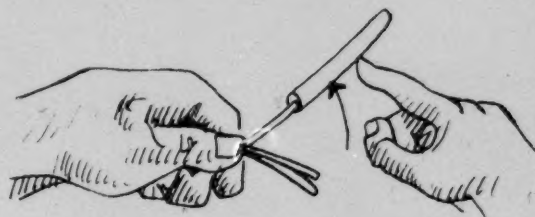
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Hold the wires with the stripped parts crossed. The insulation of all the wires should be even. Squeeze the wires very tightly between the thumb and index finger.



2. With the other index finger, push the wires to bend them.



3. Place the wires between the jaws of the side cutters just above the cross. Turn the wires $\frac{1}{2}$ turn then clockwise a full turn.



4. Remove the side cutters and turn them back. Replace them on the wires just above the twist. Turn them clockwise a full turn.



5. Repeat step 4 until the wires are twisted to the end.

6. If the insulation has slipped back on the wire, slide it back in place by putting one hand near the tap and pushing the insulation with the other hand.



METHOD OF EVALUATION:

The instructor will observe work.

COMPETENCY: Light a Soldering Torch

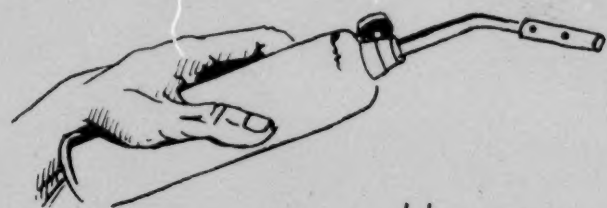
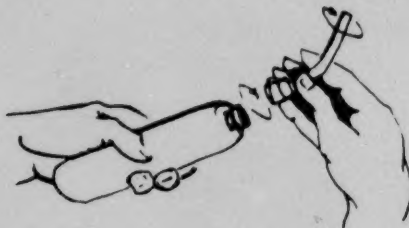
COURSE: Electrical Occupations

UNIT II: Wiring Methods

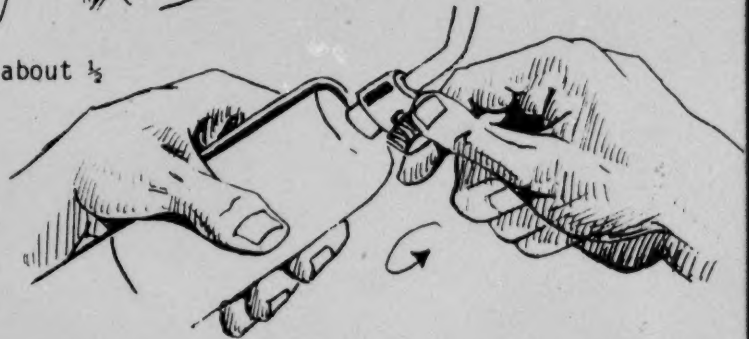
OBJECTIVE: To light the torch 10 out of 10 times

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Put the head on the torch. Turn the head clockwise until it is hand tight.



2. Turn the flame adjusting screw about $\frac{1}{2}$ turn counterclockwise.



3. Light a match and hold it about $\frac{1}{4}$ " from the head of the torch.

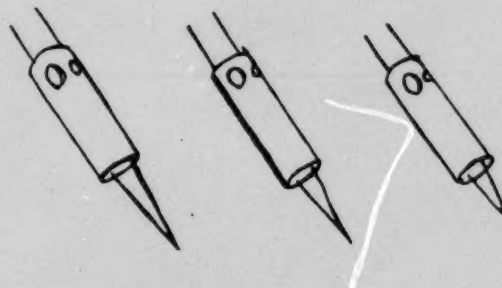


CAUTION: DO NOT get your fingers directly in front of the torch tip when you are lighting it or after it is lit.

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. After the torch is lit, turn the flame adjusting screw in either direction until the flame you want is reached.



5. To turn the torch off, turn the flame adjusting screw clockwise until it is tight. (The flame will keep burning for about 5 seconds)

CAUTION: The Neck of the torch remains hot for a while after the torch is turned off so be careful not to touch it.

METHOD OF EVALUATION:

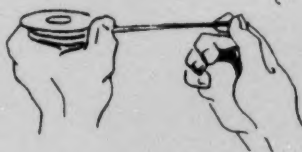
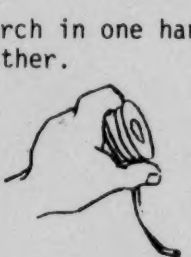
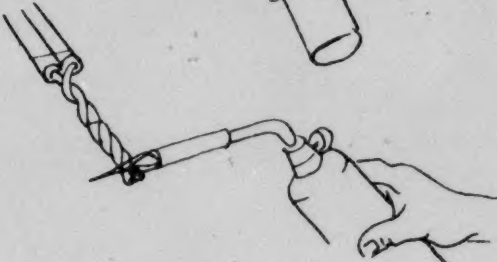
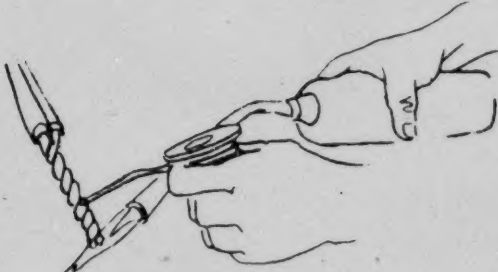
The instructor will observe the procedure.

COMPETENCY: Solder Connections with a Pencil Tip Propane Torch

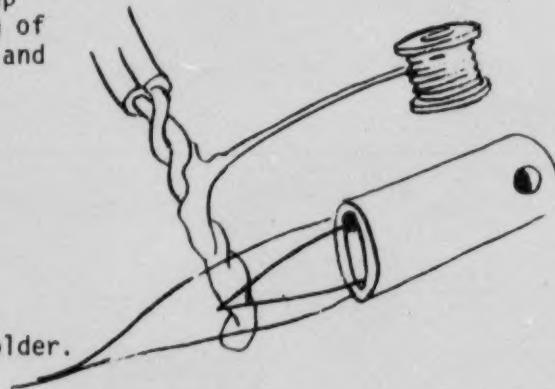
COURSE: Electrical Occupations

UNIT II: Wiring Methods

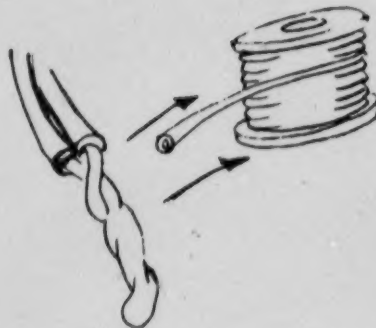
OBJECTIVE: To solder connection acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	
1. Unroll 6 or 7 inches of solder, but don't cut it off the roll.	
2. Hold the lighted torch in one hand and the solder in the other.	 CAUTION: DO NOT get your hand or arm in front of the flame.
3. Direct the flame on the tap so that the blue tip of the flame is just touching the wires.	
4. Hold the roll of solder and put the end of the solder near the beginning of the tap. Press it on very lightly.	

5. When the solder begins to melt, keep feeding the solder at the beginning of the tap until it runs down the tap and a small ball forms at the end.



6. Quickly remove the flame and the solder.



METHOD OF EVALUATION:

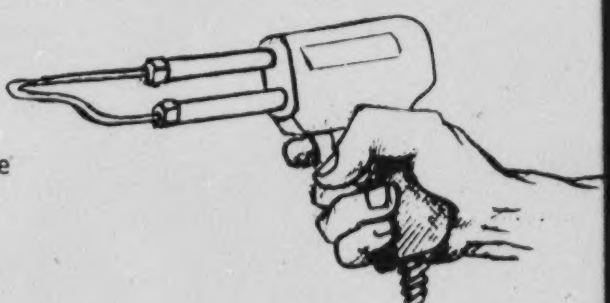
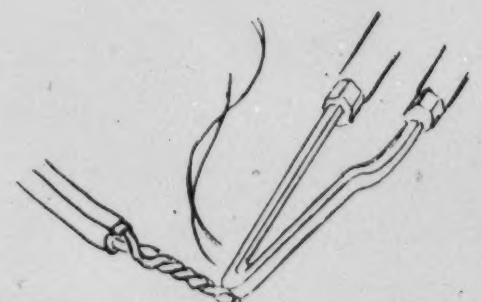
The instructor will observe the student's technique.

COMPETENCY: Solder Connections with a Solder Gun

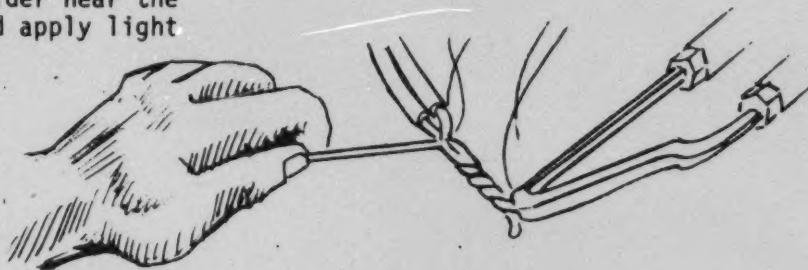
COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To solder connection acceptable to the shop standards pre-set by the shop instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Unroll about 6 inches of solder. 	CAUTION: Never touch the tip of the gun. It remains hot after the gun is turned off and can cause serious burns. 
2. Plug the solder gun in to an outlet. Hold the gun in your hand and squeeze the trigger all the way in.	CAUTION: BE CAREFUL not to let any hot solder fall on you. It can cause serious burns.
3. Put a small amount of solder on the tip.  4. Hold the rag in one hand and brush it across the tip of the solder gun. Apply some pressure but do not hold on to the tip. Keep brushing until the tip looks shiny. 5. Apply 3/8" of solder to the tip. 6. Put the solder tip on the bottom of the tap making sure that the tinned part of the tip is touching the tap.	

7. Place the end of the solder near the beginning of the tap and apply light pressure.



8. When the solder starts to melt, continue to feed solder on the beginning of the tap until the solder flows to the end.



9. Remove the solder gun from the tap and then remove the solder.

METHOD OF EVALUATION:

The instructor will examine the tap for a neat job.

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COMPETENCY: Taping Conductors

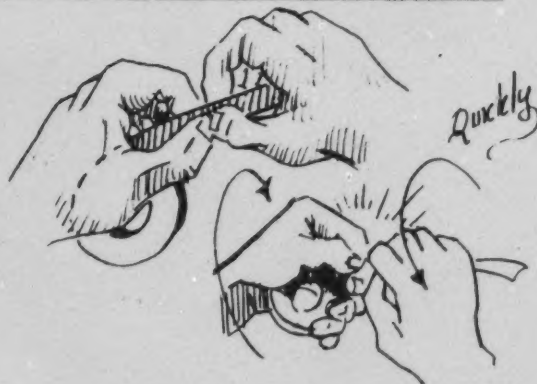
COURSE: Electrical Occupations

UNIT II: Wiring Methods

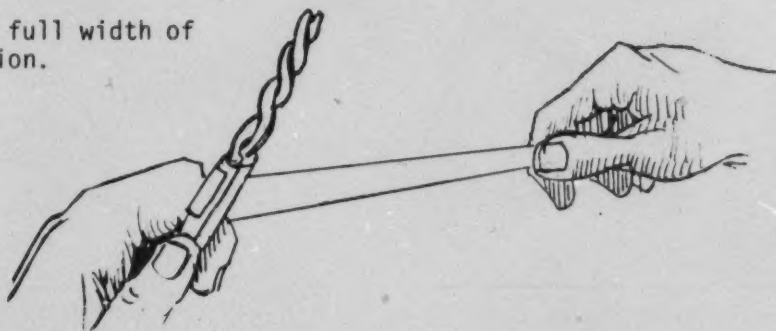
OBJECTIVE: To tape the conductors acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
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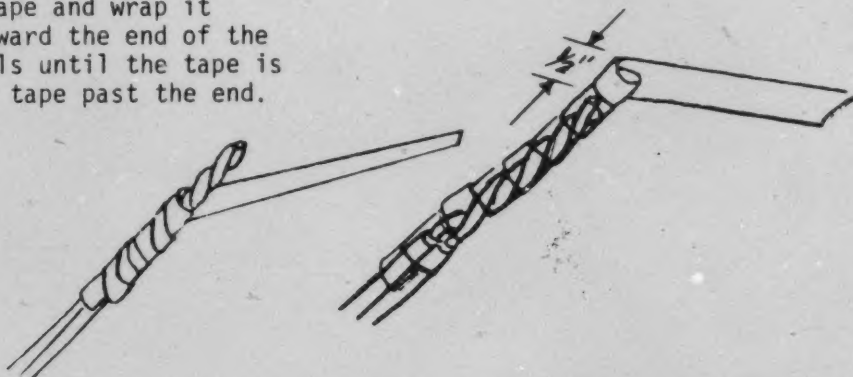
1. Unroll about 8" of tape.
2. To tear off the tape, hold your hands with your thumbs and index fingers together on the tape. Squeeze the tape very tightly. Twist your left hand clockwise and your right hand counter-clockwise very quickly.



3. Begin the tape back one full width of the tape on the insulation.



4. Keep tension on the tape and wrap it spirally clockwise toward the end of the conductor in $\frac{1}{4}$ " spirals until the tape is one full width of the tape past the end.



5. Fold the $\frac{1}{2}$ " of spiral back over the conductor and wrap the tape counter-clockwise back the conductor to where you started.



6. Tear the extra tape off.

METHOD OF EVALUATION:

The instructor will check for a neat well done job.

COMPETENCY: Tape a Connection with a Lead

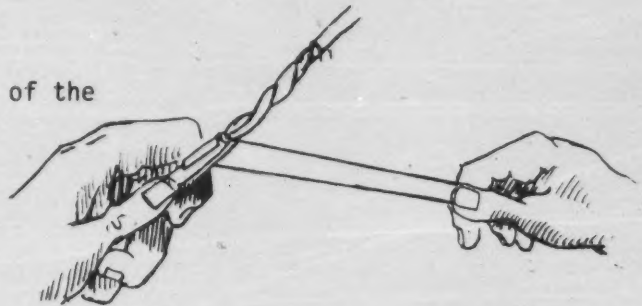
COURSE: Electrical Occupations

UNIT II: Wiring Methods

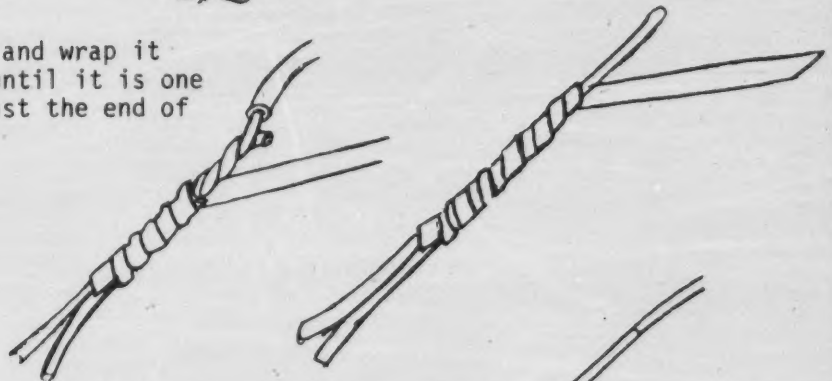
OBJECTIVE: To tape conductors having a lead acceptable to shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

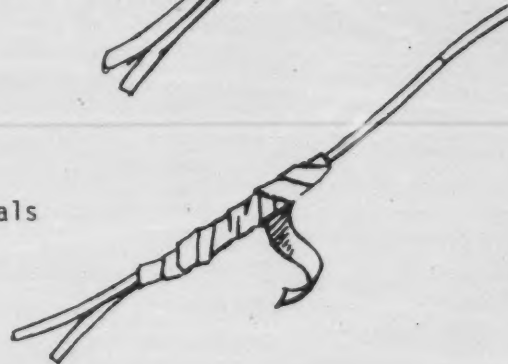
1. Unroll about 8" of tape.
2. Tear off the tape.
3. Begin the tape back one full width of the tape on the insulation.



4. Keep tension on the tape and wrap it clockwise in $\frac{1}{4}$ " spirals until it is one full width of the tape past the end of the conductors.



5. Continue wrapping clockwise in $\frac{1}{4}$ " spirals back down the connection.



6. When about $1\frac{1}{2}$ " of the tape is left, hold the wire with one hand and the tape between the thumb and index finger of the other hand and continue to wrap the rest of the tape by pushing it with your thumb.



METHOD OF EVALUATION:

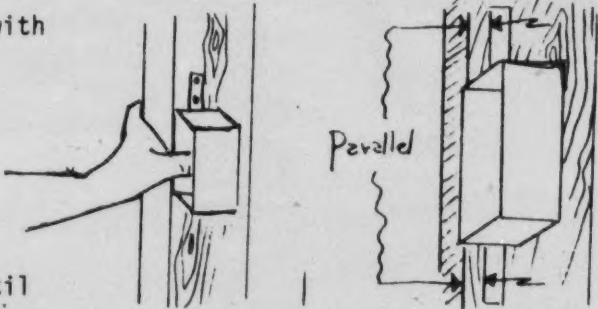
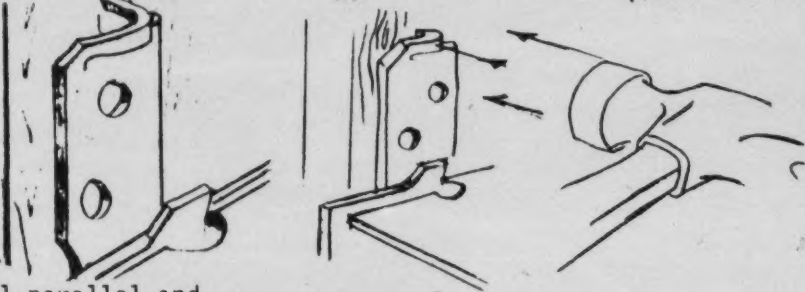
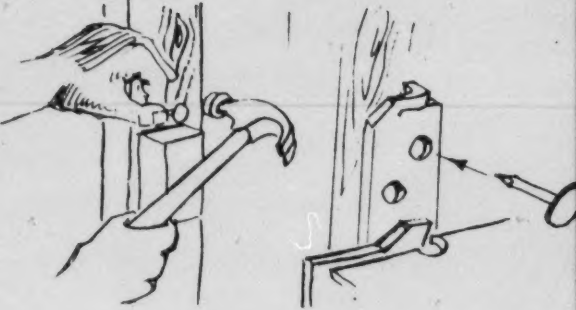
The work will be checked by the instructor for neatness.

COMPETENCY: Mount a Side Bracket Wall Case

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To mount the wall cases acceptable to shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	
1. Hold the wall case against the stud with the brackets parallel to the stud.	
2. Hammer the tab in the top bracket until it drives into the stud.	
3. Make sure the box is still parallel and drive in the bottom tab.	
4. Put a nail in the nail hole in the top bracket and drive it in. It should be long enough to go about 3/4 through the stud, but it should not go clear through.	
5. Drive another nail through the bottom bracket.	

METHOD OF EVALUATION:

The instructor will check the finished work for neatness and accuracy.

COMPETENCY: Putting Drill Bit in a Drill Motor Chuck

COURSE: Electrical Occupations

OBJECTIVE: To install drill bit - acceptable to safety standards

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

CAUTION: Do not have the drill plugged into the outlet while you are putting in the bit.

1. Open the chuck by turning it counterclockwise with your fingers. Open it until the drill bit will slide into the chuck.



2. Push the blunt end of the bit into the chuck until it bottoms.



3. Hold the bit in the center of the chuck and turn the chuck clockwise by hand. Make sure the bit is centered in the chuck.



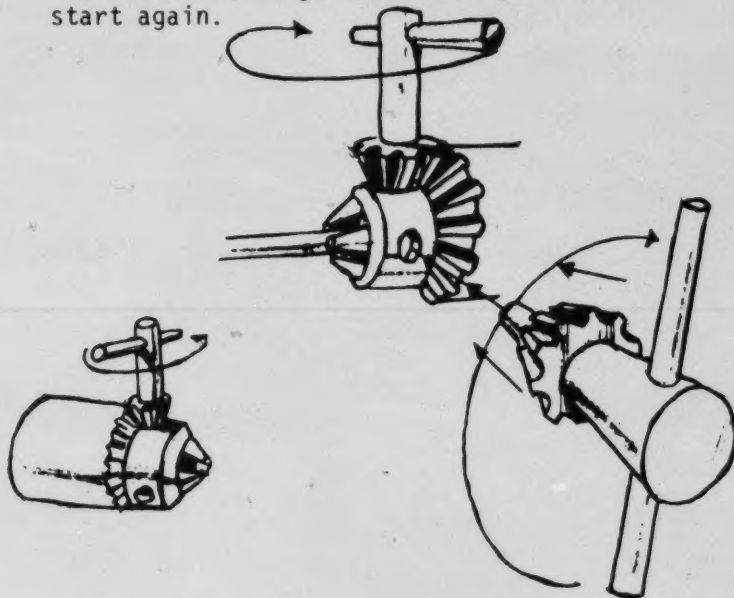
COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Tighten the chuck by turning the chuck key clockwise until it is tight. Move the key to the next key guide and tighten it the same way. Move to, and tighten, each key guide. Remove the key before you use the drill.



5. Plug the drill into an outlet and squeeze the trigger until the drill starts. The bit should run true and not wobble. If the bit wobbles, go back to step 1 and start again.



METHOD OF EVALUATION:

Check for proper installation of drill bit.

410

OPERATION SHEET
SC-2-16

COMPETENCY: Drill Holes in Wood Studs for Romex, using a Portable Drill

COURSE: Electrical Occupations

UNIT II: Wiring Methods

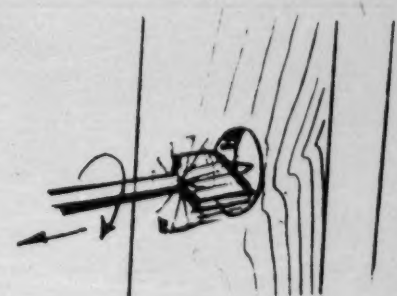
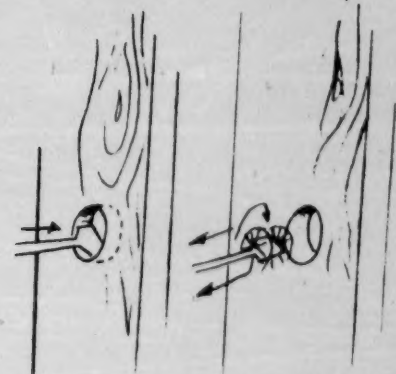
OBJECTIVE: To drill holes acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Center the bit on the stud and apply pressure on the drill. Keep the bit perpendicular to the stud and keep a good tight grip on the drill motor with both hands.
2. Squeeze the trigger and keep pushing gently. Too little pressure will make the drill bit cut too slowly. Too much pressure will make the motor stall. Continue pushing until the bit is all the way through the stud.
3. Keep the drill motor running and perpendicular to the stud. Keep a good tight grip on the motor. Use both hands and pull the motor back toward you. This makes the bit easy to take out of the hole and it cleans out the wood chips in the hole.



METHOD OF EVALUATION:

The accuracy and neatness of the job will be checked.

COMPETENCY: Install Cable

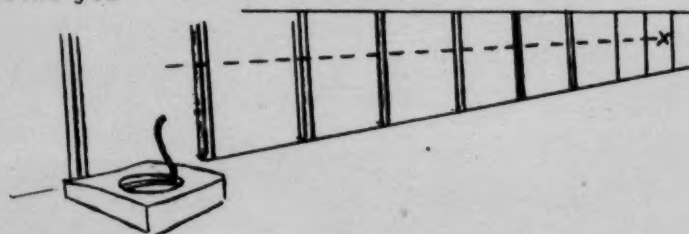
COURSE: Electrical Occupations

UNIT II: Wiring Methods.

OBJECTIVE: To install the cable acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

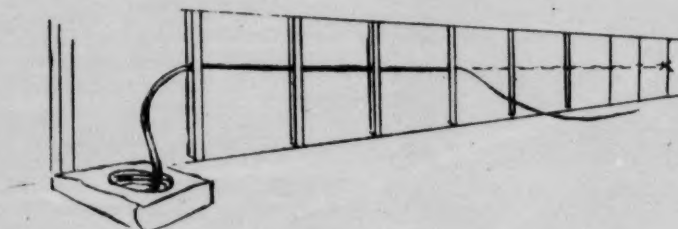
1. Place the box of wire at the point you are pulling from.



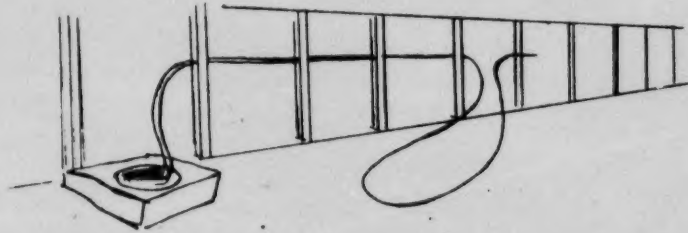
2. Place the end of the wire in the left hand leaving about 6" extending.
3. With the left hand, push the wire through the hold in the stud and grasp the end of the wire with the right hand and pull. Let the wire slip through the left hand.



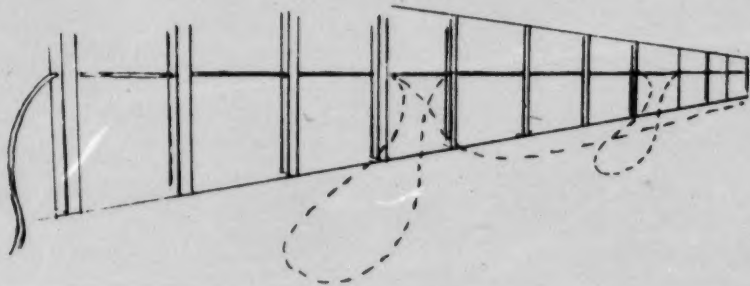
4. Only pull enough wire to go to the next stud.
5. Continue with steps 3 and 4 until you have pulled through 4 or 5 studs.
6. Pull enough wire to go to the box you are pulling to, by grasping the end of the wire tightly and pulling the wire to the box.



7. Take the wire back and pull it through 4 or 5 more studs.



8. Continue step 7 until you reach the box you are pulling to.



METHOD OF EVALUATION:

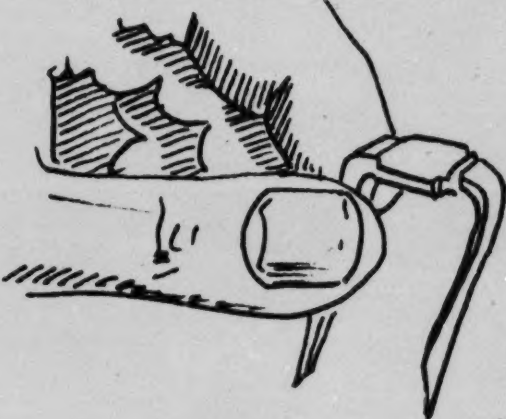
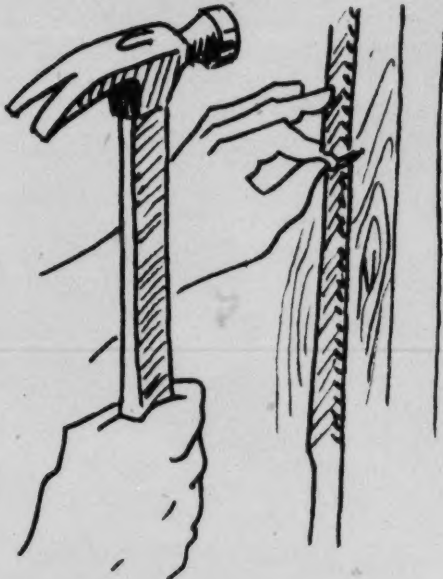
The instructor will observe work in progress as well as finished job.

COMPETENCY: Anchor Wire by Using Staples

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To anchor the wire acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the staple in one hand and the hammer in the other.	
2. Center the staple over the wire.	
3. Tap the staple several times until it starts into the wood about 1/4".	
4. Let go of the staple and continue to drive it with the hammer until it is just touching the wire.	

METHOD OF EVALUATION:

The instructor will observe the operation.

COMPETENCY: Remove a Knock-out (K.O.)

COURSE: Electrical Occupations

UNIT II: Wiring Methods

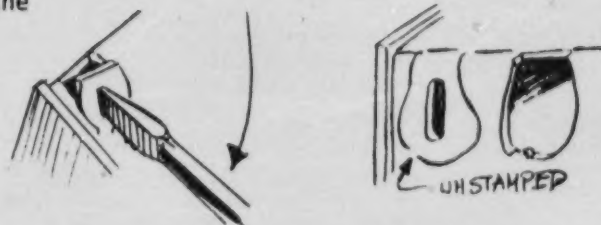
OBJECTIVE: To remove the knock-out (K.O.)

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Place the screwdriver blade in the slot in the K.O.



2. Pry the screwdriver handle toward the unstamped part of the K.O. and pull the K.O. up.



3. Move the screwdriver handle from side to side until the K.O. breaks out.



METHOD OF EVALUATION:

The instructor will check to see if work was done properly.

COMPETENCY: Strip Romex.

COURSE: Electrical Occupations

UNIT II: Wiring Methods

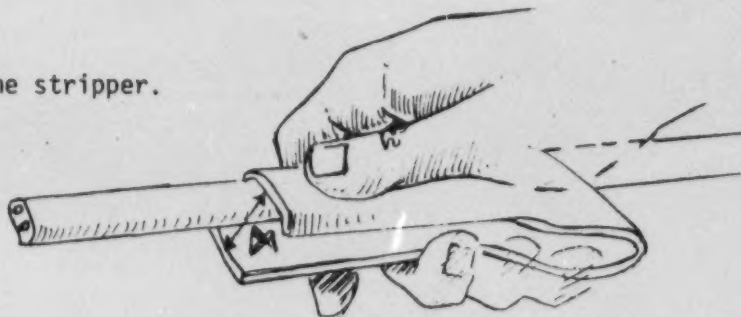
OBJECTIVE: To strip romex acceptable to shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

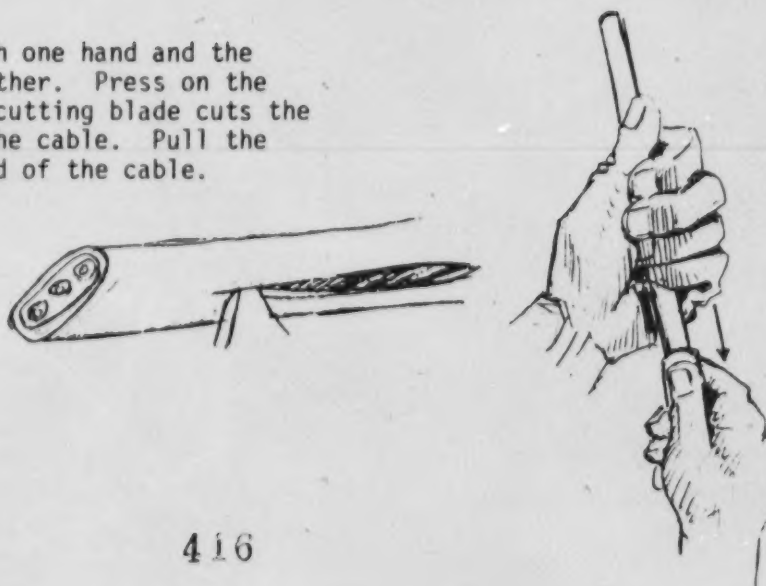
1. Be sure that all conductors are cut evenly and that one has not been bent in a hook. The hook could tear your hand when the wire stripper is used.



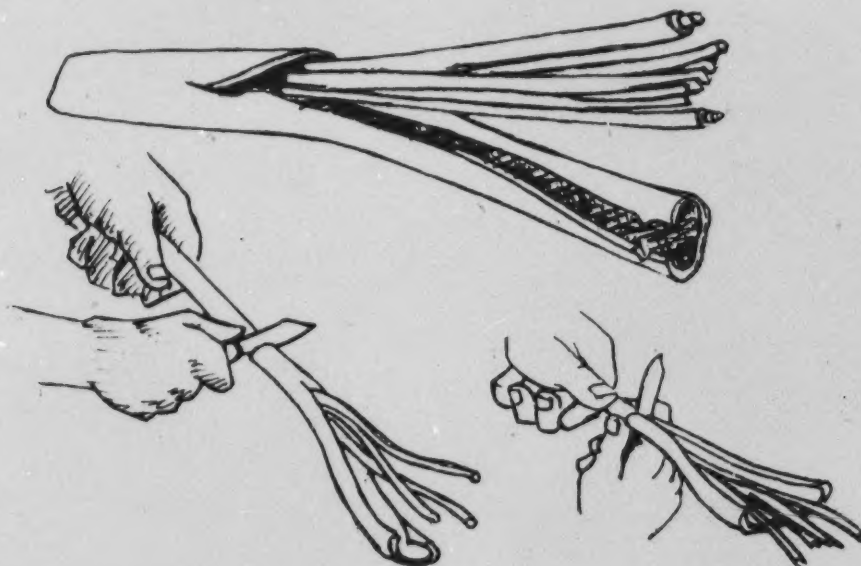
2. Insert the cable through the stripper.



3. Grasp the cable with one hand and the stripper with the other. Press on the stripper until the cutting blade cuts the outer covering of the cable. Pull the stripper off the end of the cable.



4. Peel off the split cover and trim the outer covering neatly with a knife. Be careful not to cut the conductor insulation.



METHOD OF EVALUATION:

The instructor will observe the work.

COMPETENCY: Clamp Cable to Wall Case

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To clamp the cable to the wall case acceptable to the shop standard pre-set by the instructor

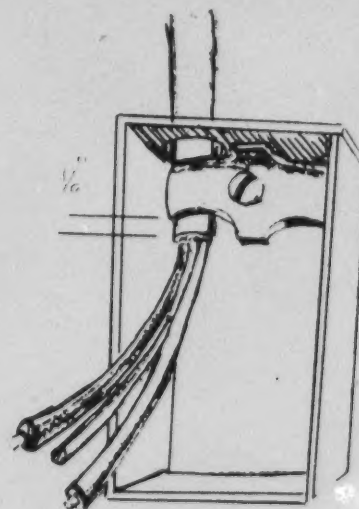
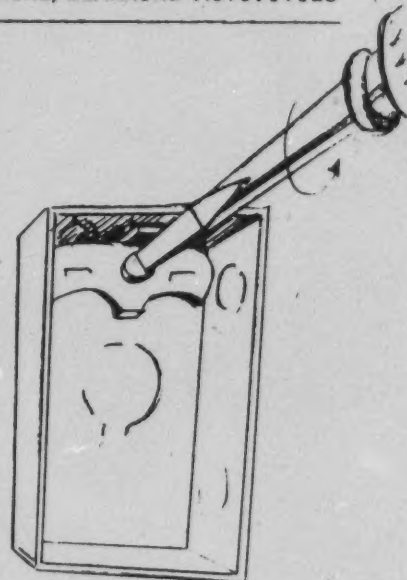
COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Loosen the cable clamp in the case about 5 full turns counterclockwise.

2. Place romex in K.O. hole. Reach in the case and pull the wires out.

3. Pull the wires through the case until the outer covering of the romex is about 1/8" below the bracket.

4. Tighten the clamp screw with a screwdriver until you feel the clamp begin to tighten on the cable. Give the screw about one more full turn.



METHOD OF EVALUATION:

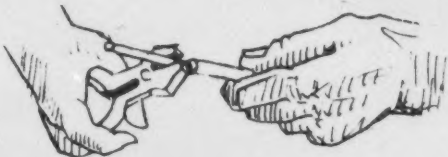
The instructor will check for a neat tight fitting job.

COMPETENCY: Bend a Hook Eye on Wire

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To bend a hook eye on the wire acceptable to shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the stripped wire in one hand and the pliers in the other.	
2. Hold the pliers near the insulation and squeeze them.	
3. Bend the wire up about 40° with the pliers. At the same time, twist the pliers counter-clockwise.	
4. Move the pliers to the tip of the wire and hold the wire about 1/4" into the jaws of the pliers.	
5. Hold both the wire and the pliers tightly and roll the pliers clockwise.	

METHOD OF EVALUATION:

The instructor will check the finished hook eye.

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COMPETENCY: Connect Devices Using Screws

COURSE: Electrical Occupations

UNIT II: Wiring Methods

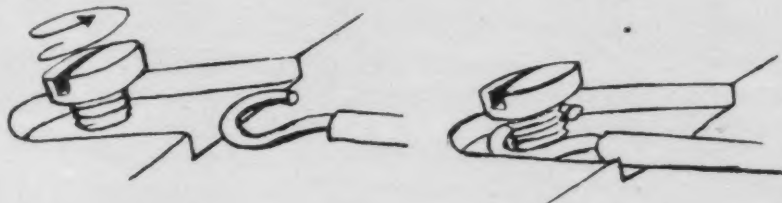
OBJECTIVE: To connect the wires to the devices acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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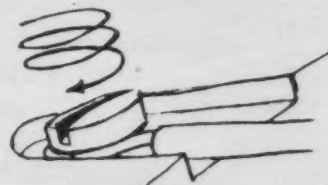
1. With a screwdriver, loosen the screws on the device.



2. Bend a hook on the wire and hook it around the screw clockwise.



3. Screw the screw in clockwise until it is tight.



METHOD OF EVALUATION:

The instructor will observe the work in progress.

COMPETENCY: Install Ground Splice Caps

COURSE: Electrical Occupations

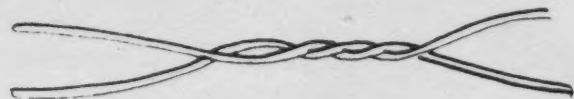
UNIT II: Wiring Methods

OBJECTIVE: To install ground splice caps on wire acceptable to the N.E.C.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

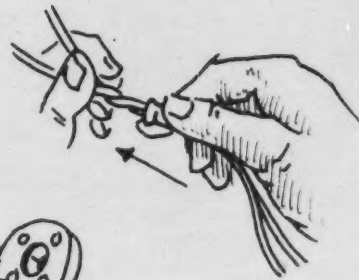
1. Twist the taps.



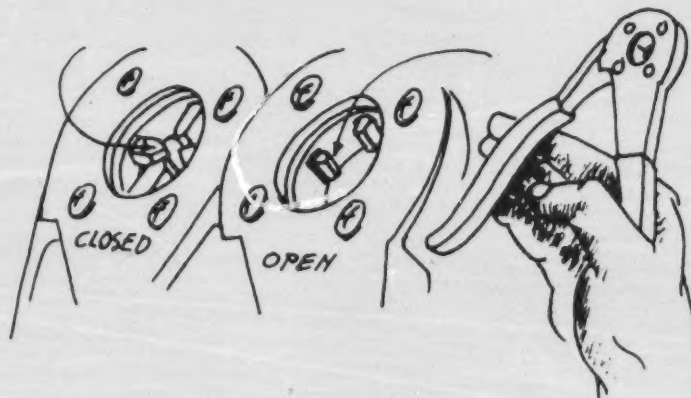
2. Place the splice cap in your right hand as shown.



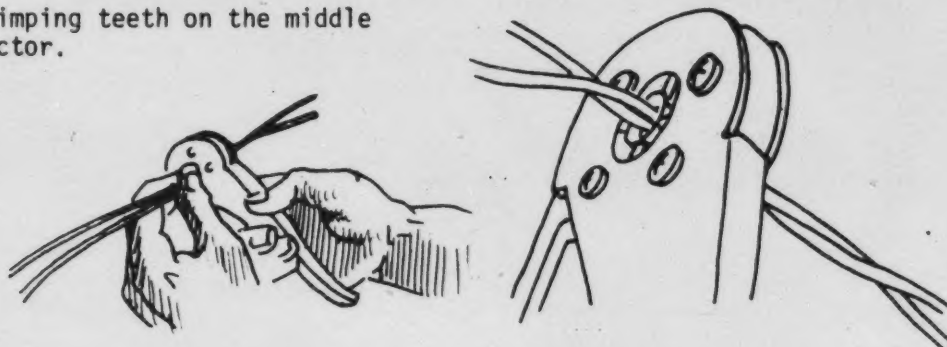
3. Slide the splice cap up to the middle of the twist as shown.



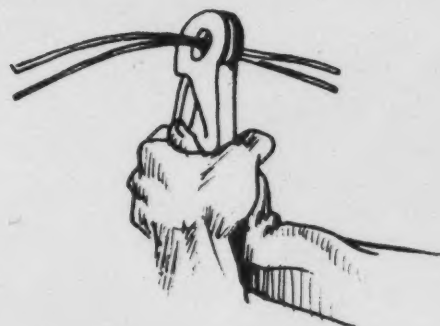
4. Hold the crimpers in your right hand as shown. Slide them up the wires.



5. Place the crimping teeth on the middle of the connector.



6. With both hands, squeeze the crimpers shut tightly.



7. Release the handles and slide the crimpers back off.

METHOD OF EVALUATION:

The instructor will observe the student's technique.

COMPETENCY: Install a Light Bar Hanger

COURSE: Electrical Occupations

UNIT II: Wiring Methods

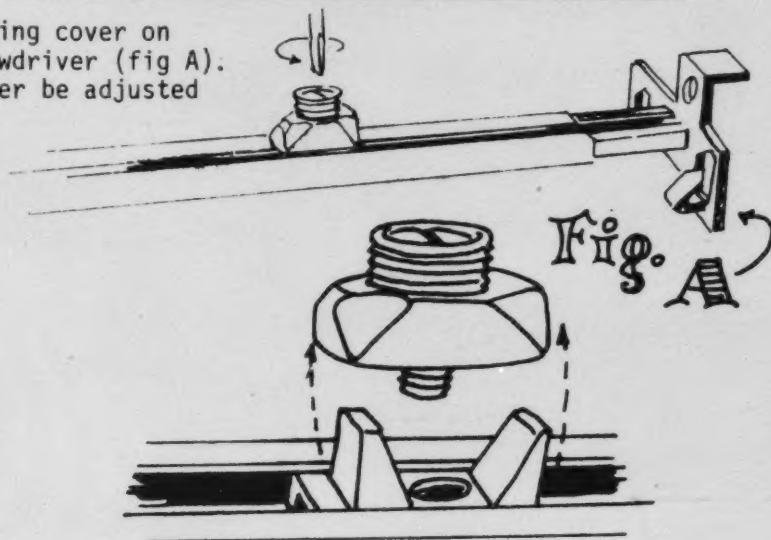
OBJECTIVE: To install a light bar hanger acceptable to shop standards pre-set by the shop instructor

COMPETENCE - PROCEDURE/STEPS

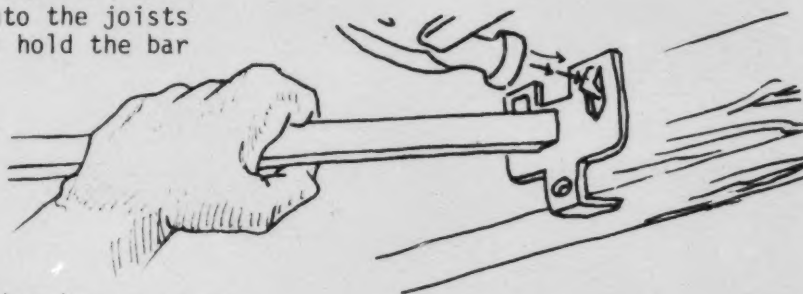
The student will be able to:

TEACHING/LEARNING ACTIVITIES

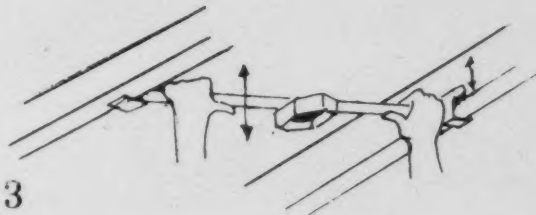
1. Remove the screw and the wing cover on the bar hanger with a screwdriver (fig A). This will let the bar hanger be adjusted for length. (fig B)



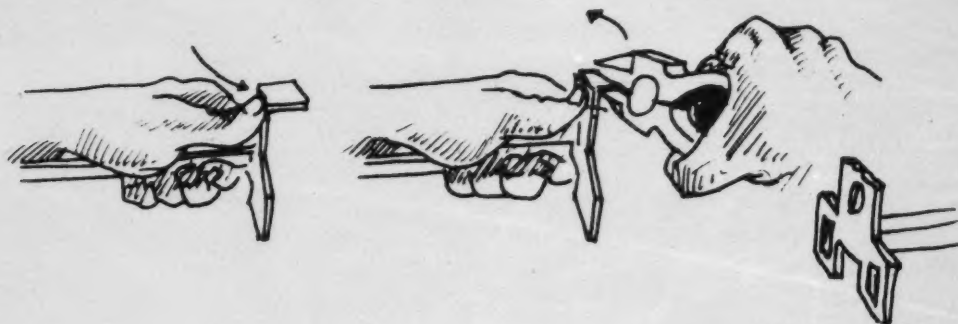
2. Hold the bar hanger with one hand and pound the holding tabs into the joists with a hammer. This will hold the bar temporarily.



3. With both hands push the bar hanger up or down to the height you want.



4. If the bar hanger will not go in far enough, break off the tabs. Hold the tab between the jaws of the side cutters. Bend the tab up while you push against the tab arm with your other thumb.



METHOD OF EVALUATION:

The instructor will check the finished operation.

COMPETENCY: Install Wire Nuts

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install wire nuts acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the wires in one hand and the wire nut in the other hand between the thumb and the index finger.	
2. Push the wire nut onto the wires and begin to twist it clockwise.	
3. Continue to turn the wire nut until it bottoms. The wire nut has bottomed when the insulation begins to twist.	

METHOD OF EVALUATION:

The instructor will observe work being done.

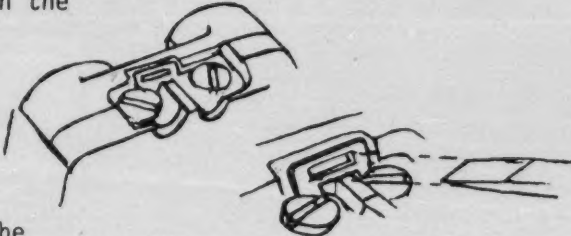
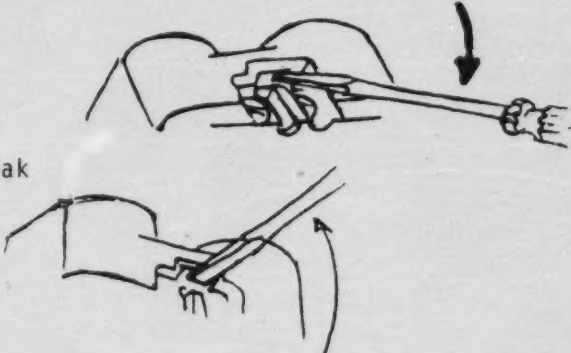
OPERATION SHEET
SC-2-27

COMPETENCY: Break Off Connecting Links on a Duplex Receptacle Making a Split Circuit Outlet

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To break off the connecting link without damaging the receptacle

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the receptacle in the left hand and turn the wire attaching screws all the way in.	CAUTION: ALWAYS USE a $\frac{1}{4}$ " blade screwdriver.
2. Place the blade of the screwdriver in the slot of the connection link.	
3. Pull the screwdriver forward until the blade of the screwdriver touches the plastic part of the receptacle.	
4. Push the screwdriver back toward the original position and the link will break off.	

METHOD OF EVALUATION:

The instructor will be observing.

COMPETENCY: Remove a Knockout

COURSE: Electrical Occupations

UNIT II: Wiring Methods

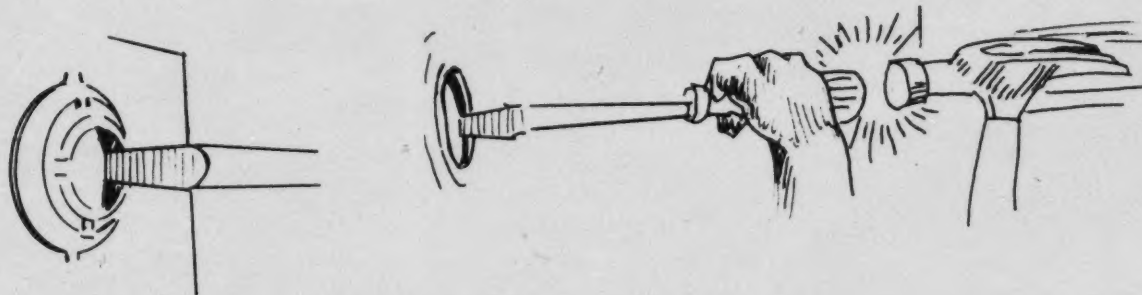
OBJECTIVE: To remove the smaller (K.O.) knock-out without removing the larger ones

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
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The student will be able to:

1. Remove the center knockout by placing the screwdriver blade at the point on the K.O. across from the tie. Strike the screwdriver handle with the hammer so the K.O. is pushed inward.

CAUTION: Make sure that your hand is not behind the handle of the screwdriver.



2. Remove the second ring inward by striking the screwdriver - with the blade midway between ties - then bending ring sections inward and back and forth to break the ties.



METHOD OF EVALUATION:

The instructor will be observing the student's technique.

COMPETENCY: Install Connectors

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install connectors acceptable to the N.E.C.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Hold the connector and unscrew the lock nut.



2. Place the connector in the K.O. hole with your left hand and with the screw facing you as shown.

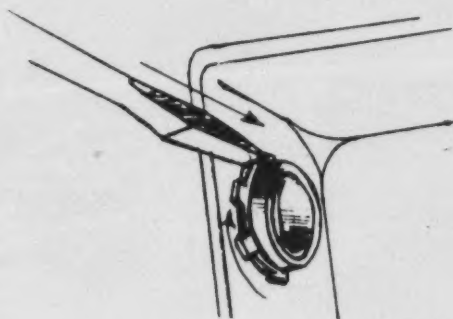


3. With your right hand, screw the lock nut on finger tight, making sure that the serrated teeth on the lock nut are pointed upward.



4. Place the screwdriver blade in the teeth of the lock nut and drive the lock nut on tight in a clockwise direction.

CAUTION: Make sure your hand is not back over the handle of the screwdriver.



5. You can tell when the lock nut is tight enough, when you see a scratch line on the box where the teeth have dug in.



METHOD OF EVALUATION:

The instructor will check the finished job.

COMPETENCY: Cut B.X. Cable

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To cut the cable acceptable to shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Hold BX cable in your hands and squeeze the cable until you see the outer metal covering break open.



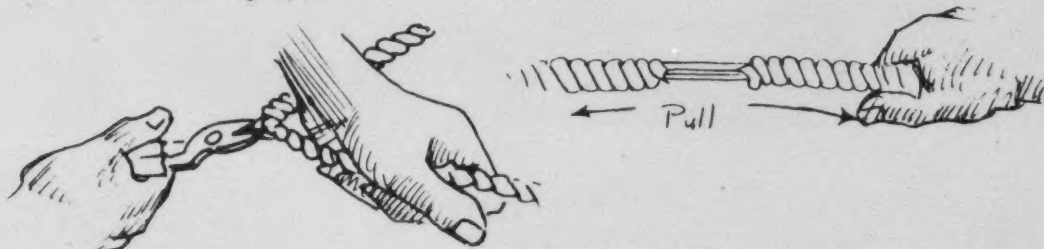
2. Place the BX cable in your hands, and get a good tight grip on it so the cable does not slip.



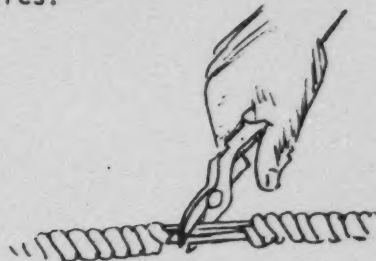
3. Twist your left hand counterclockwise and your right hand clockwise until the outer metal covering forms a loop as shown.



4. With BX cutters, cut the loop as shown. Pull the covering apart.



5. Cut the wires.



METHOD OF EVALUATION:

The instructor will observe work in progress.

COMPETENCY: Strip B.X. Cable

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To strip the cable acceptable to the N.E.C.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
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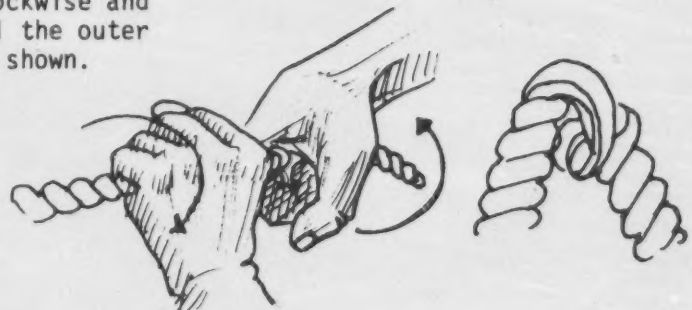
1. Hold B.X. cable in your hands and squeeze the cable until you see the outer metal covering break open.



2. Place the B.X. cable in your hands, and get a good, tight grip on it so the cable does not slip.



3. Twist your left hand counterclockwise and your right hand clockwise until the outer metal covering forms a loop as shown.



4. With B.X. cutters, cut the loop as shown in Fig. A and remove the outer covering as shown in Fig. B.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

5. With B.X. cutters, cut the loop as shown in Fig. A and remove the outer covering as shown in Fig. B.

NOTE: Be careful not to damage the insulation on the conductor with the B.X. cutters.

METHOD OF EVALUATION:

The instructor will examine the finished work.

COMPETENCY: Install an Anti-short

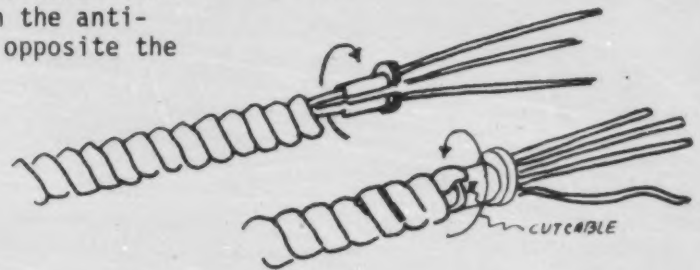
COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install anti-shorts acceptable to N.E.C.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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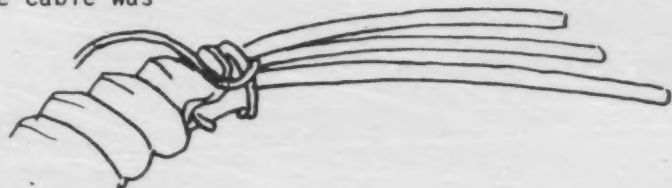
1. Place the anti-short between the conductors and the armored covering. Turn the anti-short so that the open part is opposite the point where the cable was cut.



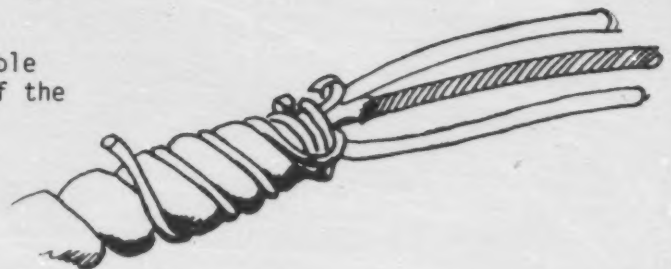
2. With your fingers, push the anti-short in to depth.



3. Bend the bare wire down over the armored cable at the point where the cable was cut.



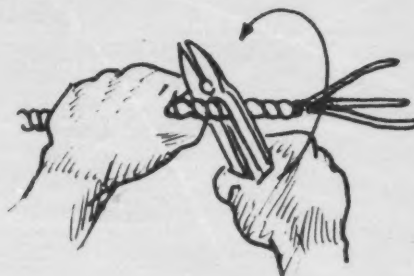
4. Twist the bare wire around the cable about four turns in the grooves of the armored covering.



5. With the B.X. cutters, clip off the extra wire.



6. With your thumb, or with the back of the B.X. cutter bend around the loose end.



METHOD OF EVALUATION:

The instructor will observe the student's work.

COMPETENCY: Cut a Hole for a Wall Case

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To cut a hole for wall cases acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Place the wall case against the wall and make sure the case is straight.



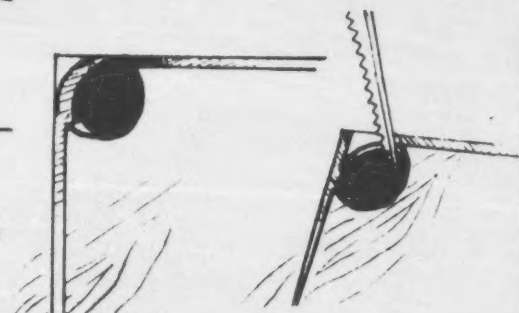
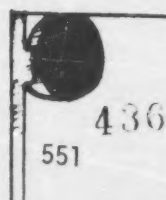
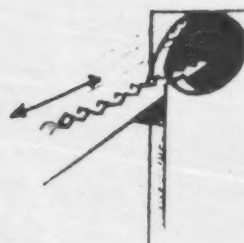
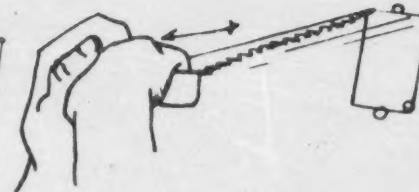
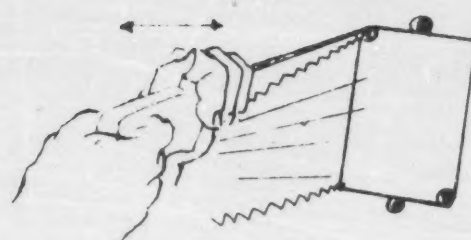
2. Mark around the wall case.



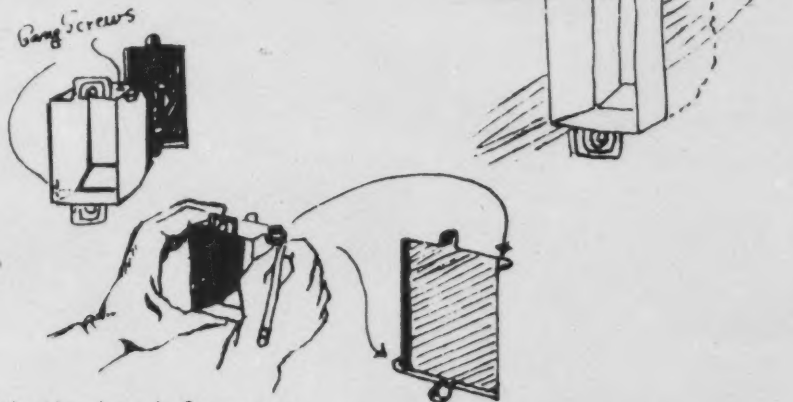
3. Drill holes as shown.



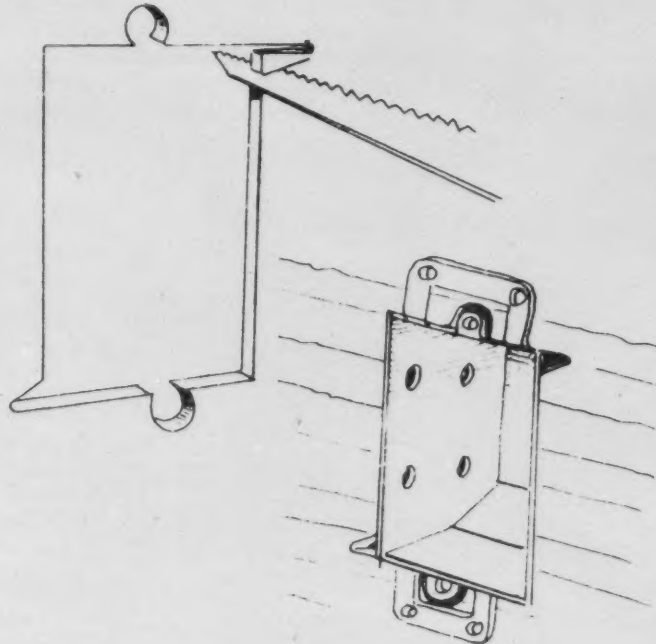
4. Cut as shown.



5. Place the wall case in the hole and mark around the box gang screws.



6. Cut these parts out with the key hole saw also.



7. Push the wall case in the hole.

METHOD OF EVALUATION:

The instructor will look for:

1. Neatness
2. Accuracy
3. Proper procedure

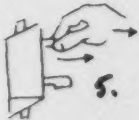
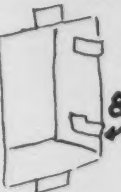
437

COMPETENCY: Install Box Holders

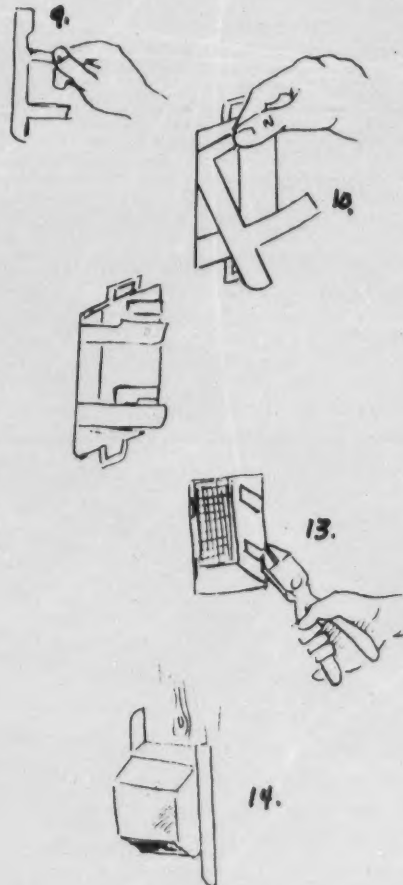
COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install the box so that it is not loose or uneven

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the box holder in one hand.	
2. Slide the bottom of the holder between the box and the wall.	
3. Push the top part of the holder back.	
4. Move the holder up about 1/2".	
5. This is how the back of the box and the holder look when they are in place.	
6. Push on the box with your left hand and bend the holder as shown with your right hand.	
7. Push on the holder with your thumb until the holder wraps back into the box.	
8. Repeat step 7 with the bottom tab.	

9. Hold the box holder as shown.
10. Push the holder up in as shown.
11. Push the bottom of the holder in and slide the holder down $\frac{1}{2}$ ".
12. Repeat steps 5 to 8.
13. Place the side cutters on the holder and pinch the tabs tight on the side of the box.
14. This is how the back of the box and the holder look when they are in place.



METHOD OF EVALUATION:

The instructor will check:

1. Neatness
2. Accuracy
3. Quality of finished product

COMPETENCY: Cut Large Cable or Wire

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To cut the cable to the length specified by the instructor

COMPETENCE - PROCEDURE/STEPS

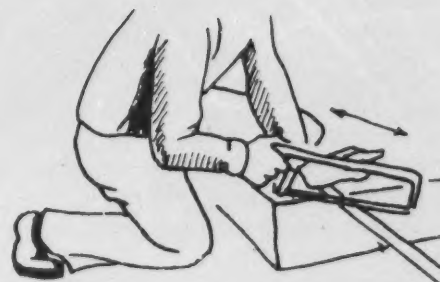
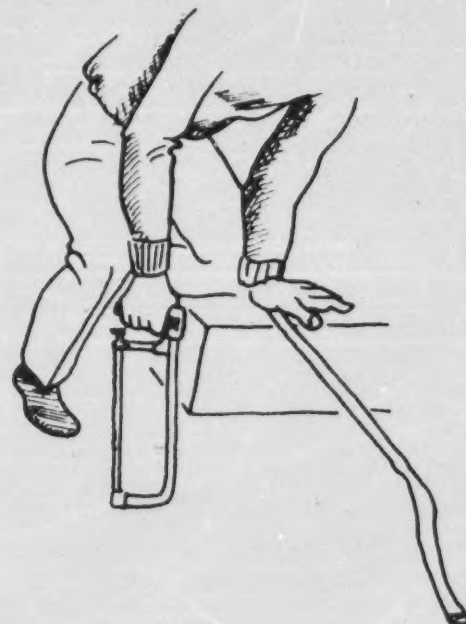
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Place the cable on a flat surface with the end hanging over the edge.

2. Put your knee and hand on the cable and push down on it.

3. With the hack saw, cut the cable as shown.



METHOD OF EVALUATION:

The instructor will check for proper procedure.

COMPETENCY: Strip Cable

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To strip the cable acceptable to the standards set by N.E.C.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Place the cable on a flat surface.

2. Anchor the cable with your left hand as shown. With your right hand, place the knife blade in the middle of the cable.



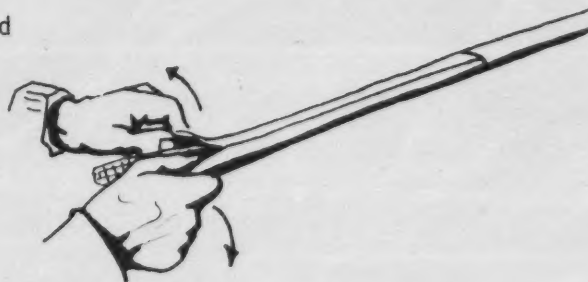
3. Pushing slightly, pull the knife down the length of the cable. Be careful not to cut through the cable covering.



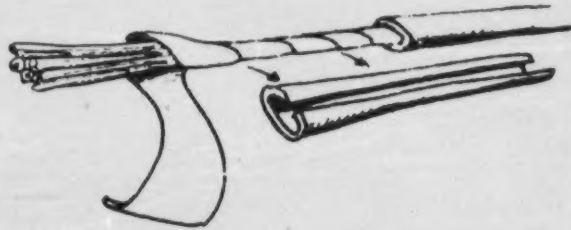
4. Hold the cable and cut completely around it.



5. Tear off the covering along the marked line.



6. With your pocket knife, cut off any paper that may be around the cable.



METHOD OF EVALUATION:

The instructor will check for proper procedure.

COMPETENCY: Measure and Mark a Line

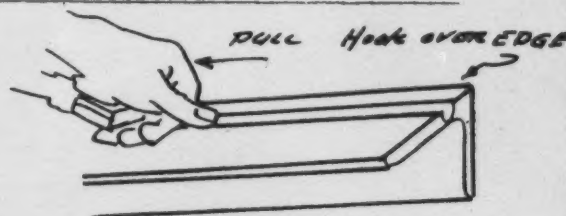
COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To measure and mark a line according to the shop standards pre-set by the instructor

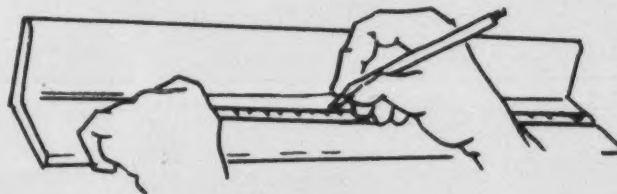
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Hook the tape over the edge of the stock.



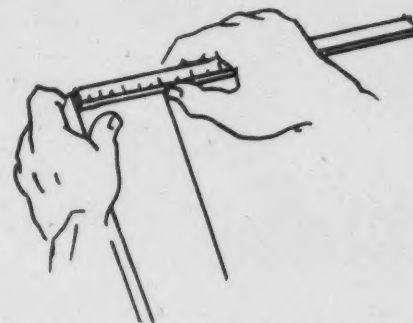
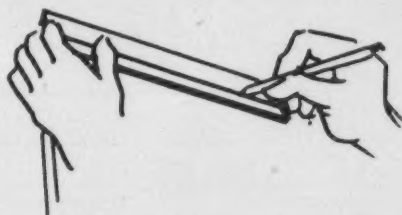
2. Pull the tape out far enough to make the measurement.

3. Read or mark the dimension.



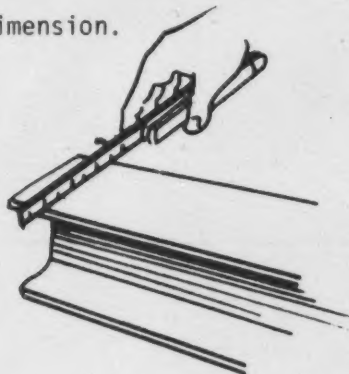
4. Unfold the rule longer than the space to be measured.

5. Hold the rule flat on the surface to be measured.



6. Hold the end of the rule at one end of the stock.

7. Read or mark the dimension.



NOTE: To take a very accurate measurement, hold the edge of the rule against the surface of the object being measured. This will prevent errors resulting from the thickness of the rule.

8. Fold the rule.

METHOD OF EVALUATION:

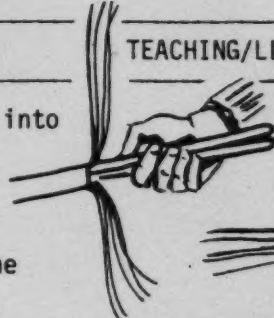
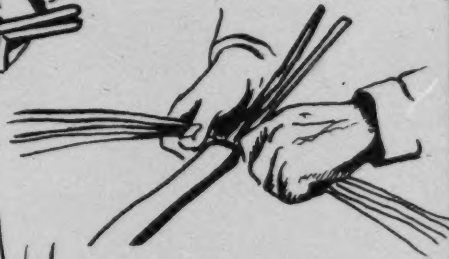
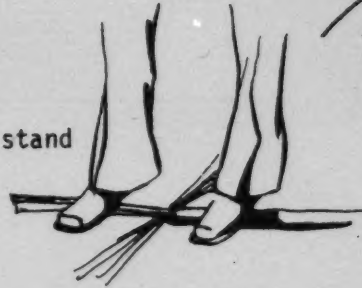
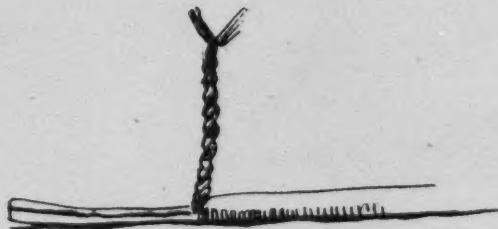
The instructor will check for proper procedure.

COMPETENCY: Braid Neutral Wire

COURSE: Electrical Occupations

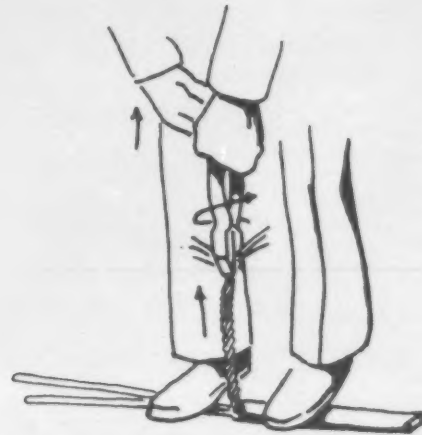
UNIT II: Wiring Methods

OBJECTIVE: To braid the neutral conductor to meet the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Divide the strands of the conductors into two groups.	
2. Place your hands as shown and pull the groups apart.	
3. Place the cable on the ground and stand on it.	
4. Hold the strands as shown and twist them clockwise.	
5. Let go of the strands and switch hands. Twist them again and pull them upward at the same time.	
6. Continue step 5 until the groups are braided as far as they can be by hand.	

7. Place the side cutters on the groups of wires and keep twisting them clockwise like you would twist a tap.

8. Snip off the frayed ends with the side cutters.



METHOD OF EVALUATION:

The instructor will observe the student's procedure.

COMPETENCY: Install a Weatherhead

COURSE: Electrical Occupations

UNIT II: Wiring Methods

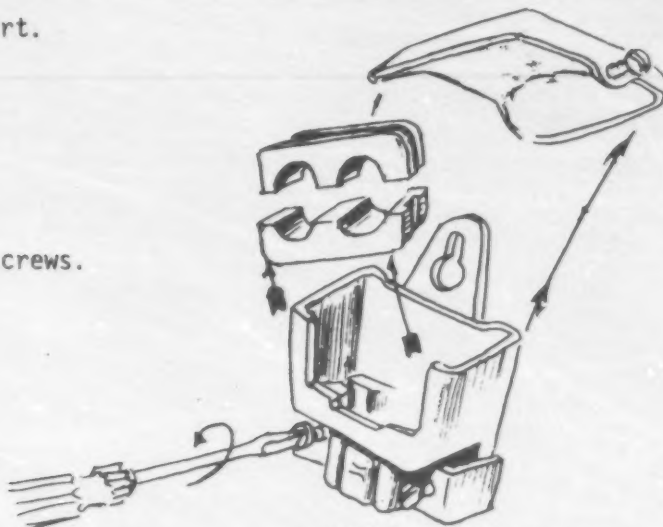
OBJECTIVE: To install a weatherhead to meet the N.E.C. laws

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

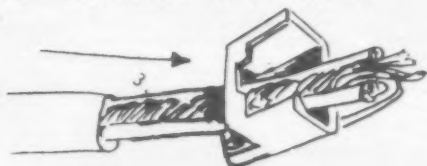
1. Take the weatherhead apart.

2. Loosen the cable clamp screws.

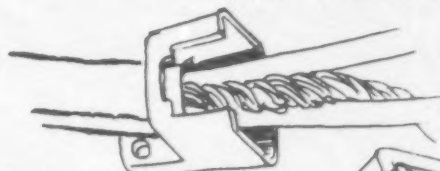


3. Put the cable in as shown.

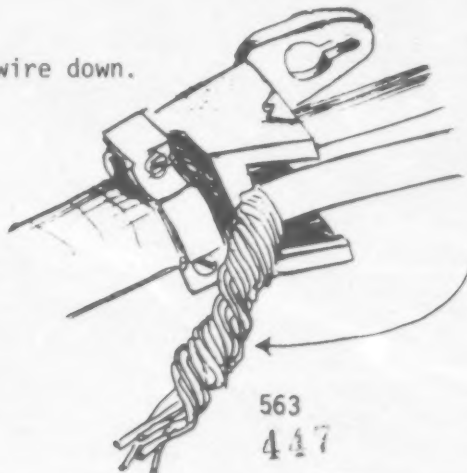
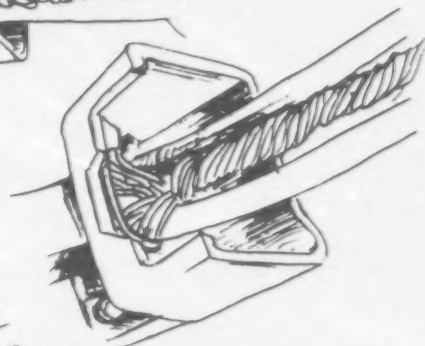
NOTE: the depth the insulation is inserted.



4. Tighten the cable clamp securely but don't tighten it so tight that it will crush the insulation.



5. Bend the neutral wire down.



6. Insert one of the bushings.

7. Bend the insulated conductors into the bushing.

8. Insert the other bushing.

9. Place the weatherhead cap on the body and tighten the screws.

NOTE: Do not overtighten the screws. They will strip easily.

*Do not
overtighten*

METHOD OF EVALUATION:

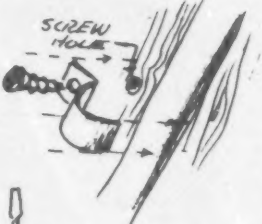
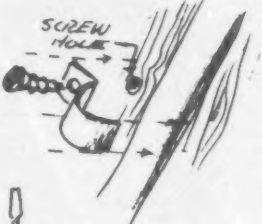
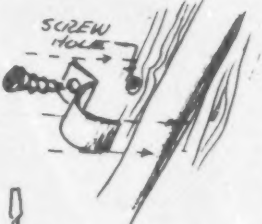
The instructor will observe the work.

COMPETENCY: Strap Cable or Conduit to Wood or Wood Products

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To strap cable to wood products acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the strap in your left hand.	
2. Place the strap on the cable.	
3. With a pencil, mark the hole.	
4. Remove the strap and put it in your pocket.	
5. Hold the screw as shown and tap it with a hammer until it just starts into the wood.	
6. Turn the screw in 2 or 3 turns with the screwdriver. Keep pressure on the screwdriver and the head of the screw.	
7. Back the screw out.	
8. Place the strap on the cable.	
9. Hold the strap and the screw as shown.	

10. Tighten the screw.



METHOD OF EVALUATION:

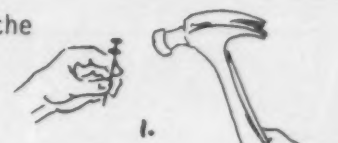
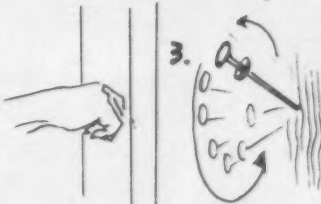
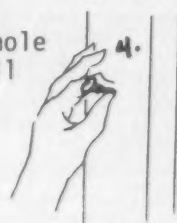
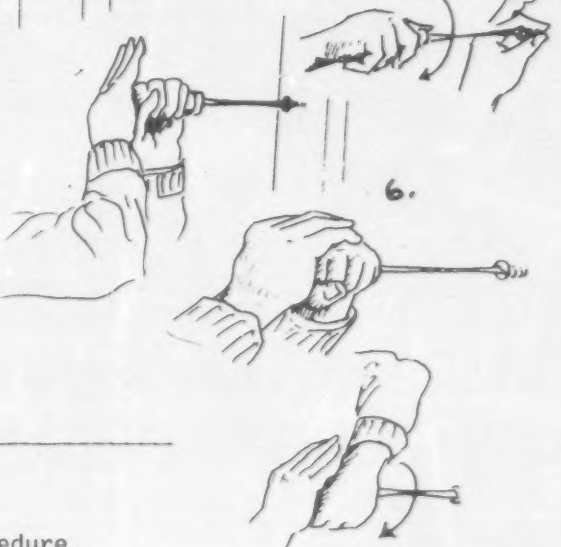
The instructor will check to see that the proper procedures are followed.

COMPETENCY: Install Wood Screws

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install wood screws acceptable to the shop standards pre-set by the instructor

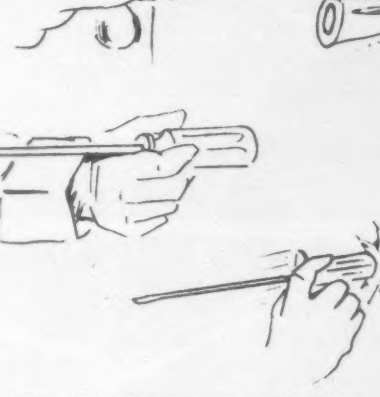
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the nail in your left hand and the hammer in your right hand.	
2. Hold the nail on the spot where you plan to install the screw and hammer the nail in about 1/4".	
3. Take hold of the nail and work your hand in circles until the nail comes out.	
4. Place the point of the screw in the hole and hold it as shown so the screw will start straight.	
5. Place the screwdriver in the slot and turn the screw in a clockwise direction. Push downward on the screwdriver until the screw starts in a few threads.	
6. Hold your hands as shown and continue to turn the screw in.	
METHOD OF EVALUATION: The instructor will check for proper procedure.	

COMPETENCY: Install Plastic Anchors

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install plastic anchors acceptable to the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place an anchor against the drill bit. Mark the depth of the anchor on the drill bit with a pencil.	CAUTION: MAKE SURE the drill is unplugged.
2. Drill a hole to the marked depth.	
3. Hold the anchor with the small end toward the hole.	
4. Put the anchor into the hole.	
5. Hold the screwdriver in your right hand and tap the anchor with it until it is flush with the block.	

METHOD OF EVALUATION:

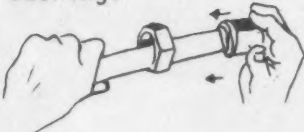
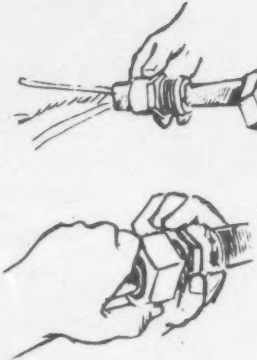
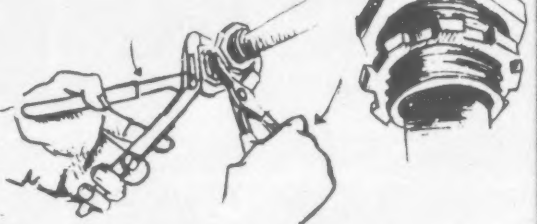
The instructor will observe the student.

COMPETENCY: How to Install Weatherproof Connectors

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install a weatherproof connector to meet the N.E.C. laws

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Take apart the connector.	
2. Put the compression nut on the wire.	
3. Install the rubber bushing.	
4. Put the body of the connector on the wire. Note which way to put it.	
5. Tighten the compression nut on the body with your fingers.	
6. Place the water pump pliers on the con- nector. Tighten the nut with the pliers.	

METHOD OF EVALUATION:

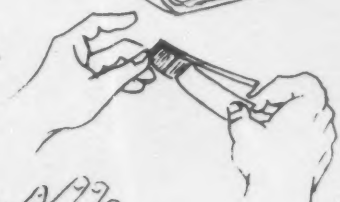
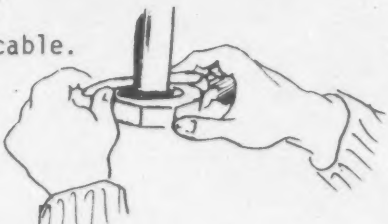
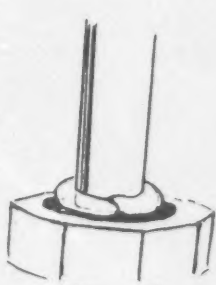
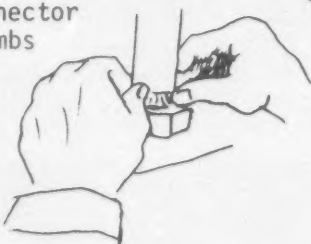
The instructor will check the finished work.

COMPETENCY: How to Seal Weatherproof Connectors

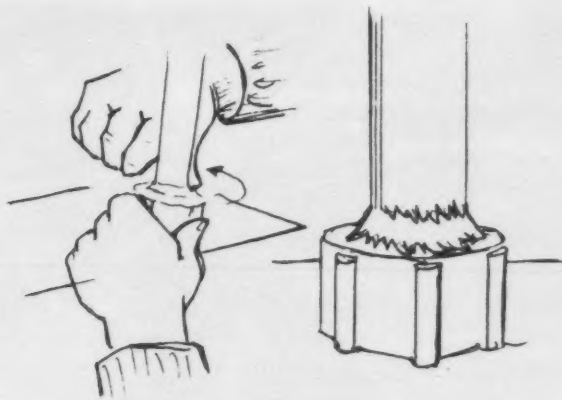
COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To seal weatherproof connectors to meet the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Unroll some of the air seal.	
2. Put the air seal on the board and slice off a piece with the knife.	CAUTION: NEVER CUT toward yourself with a knife. 
3. Peel off and throw away the paper backing.	
4. Cup the air seal between your hands and then roll it to form a small worm.	
5. Wrap the air seal around the cable.	 
6. Work the air seal down into the connector and against the cable with your thumbs and index fingers.	

7. With one thumb, rub the air seal until it is smooth.



METHOD OF EVALUATION:

The instructor will inspect the finished work.

COMPETENCY: How to Install Wire in Lugs

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install wire in a lug to meet the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

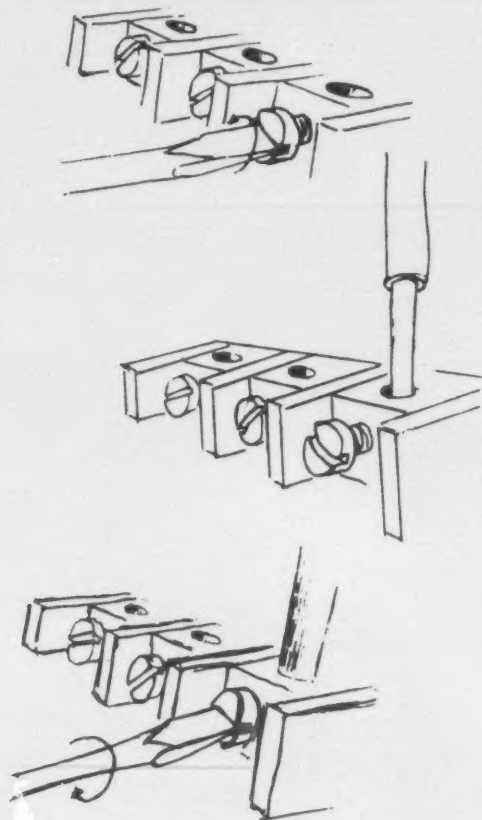
TEACHING/LEARNING ACTIVITIES

1. Loosen the screws.

2. With both hands, push the wire in the lugs. Make sure the wire is in to the bottom of the lug.



3. Tighten the lug.



METHOD OF EVALUATION:

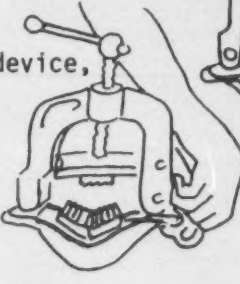
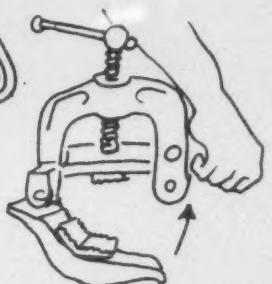
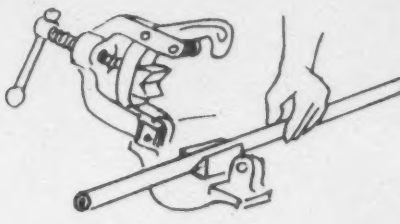
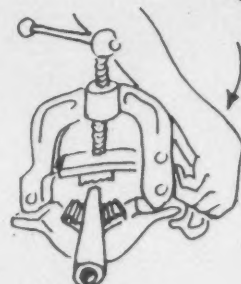
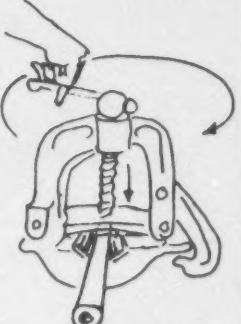
The instructor will check the finished work.

COMPETENCY: Place Tubing in Vise

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install tubing in a vise without crushing the tubing

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open the jaws of the vise by turning the handle in a counterclockwise direction. Open them wide enough to put the conduit in.	
2. If the vise has a jaw opening device, open the jaw as shown.	
3. Place the tubing in the vise.	
4. Close the vise.	
5. Turn the handle clockwise until the jaws just touch the tubing.	
6. Keep tightening the jaws until you feel the tubing snug up.	 NOTE: Do not over tighten the jaws because the jaws will crush the tubing. You will get a feel for how tight it must be with practice.

METHOD OF EVALUATION:

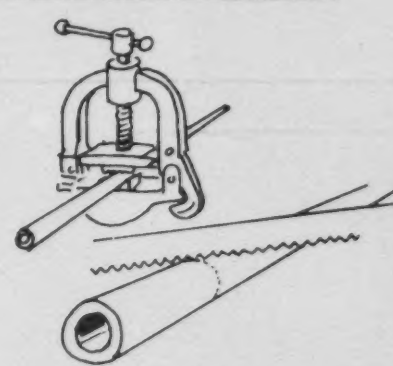
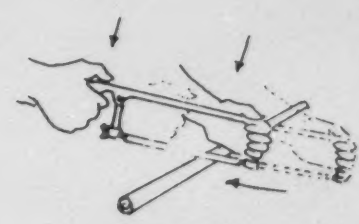
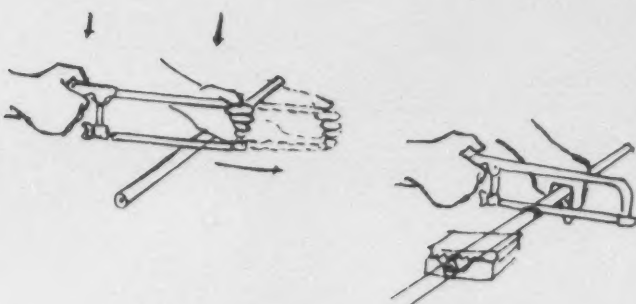
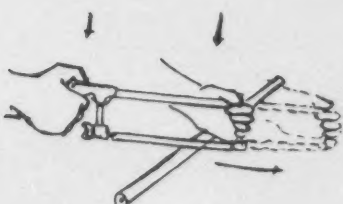
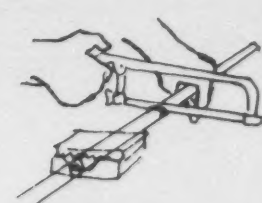
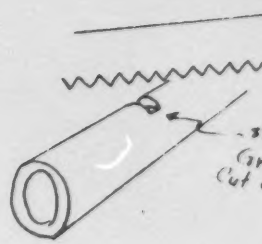
The instructor will inspect the tubing.

COMPETENCY: Cut Tubing or Pipe

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To cut tubing to meet the shop standards pre-set by the instructor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the hack saw along the line you want to cut.	
2. Push downward on the saw and pull it back toward you.	
3. Repeat steps 1 and 2 until a groove is cut in the pipe or tubing.	
 	 STARTING GROOVE Cut with all back strokes.

METHOD OF EVALUATION:

The instructor will observe the work.

COMPETENCY: How to Place Conduit in a Bender

COURSE: Electrical Occupations

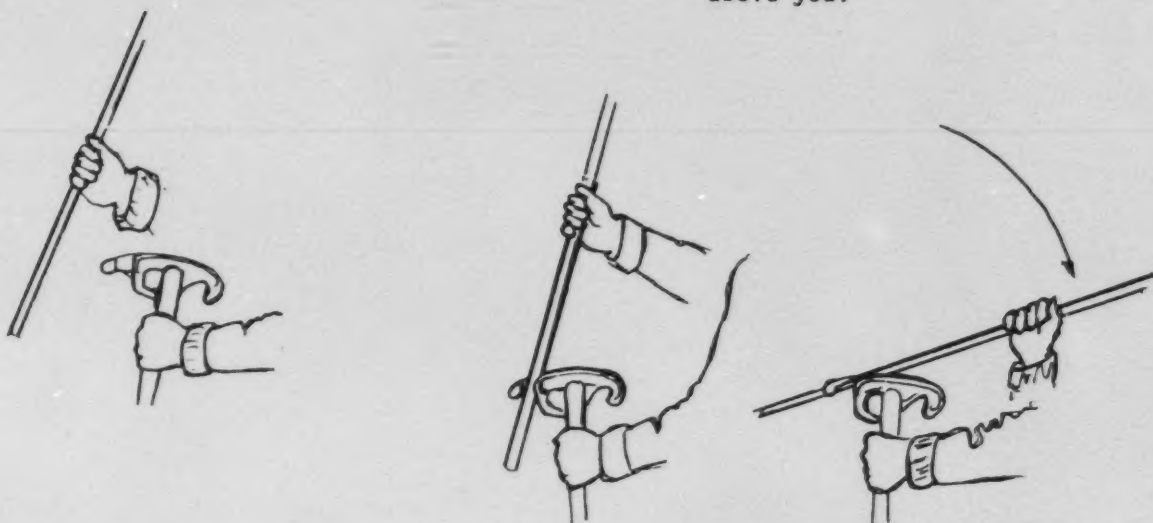
UNIT II: Wiring Methods

OBJECTIVE: To place the conduit in the bender according to the instruction sheet

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Hold the conduit in your right hand and the bender in your left.

CAUTION: WATCH ABOVE you when you are handling conduit. It comes in 10' lengths and could easily break something above you.



2. Place the conduit in the bender as shown.

METHOD OF EVALUATION:

The instructor will check when finished.

COMPETENCY: Install Set Screws Conduit Connectors

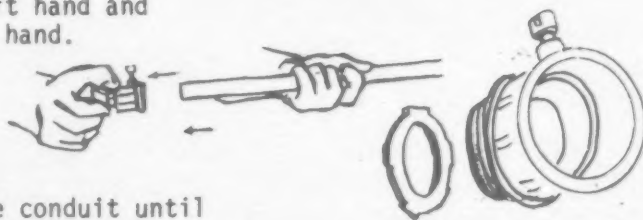
COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install set screw connectors according to the N.E.C.

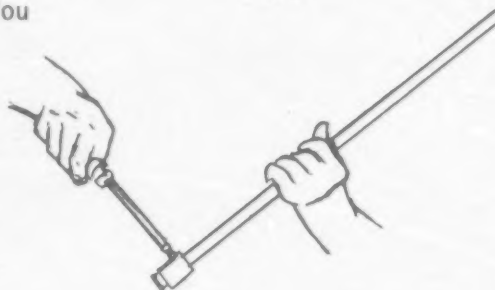
COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Hold the conduit in your left hand and the connector in your right hand.



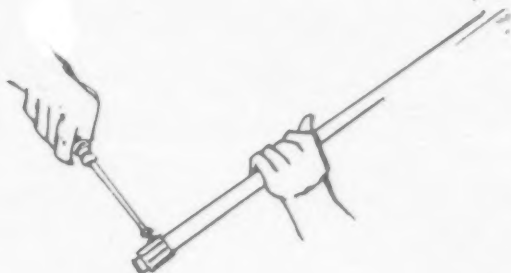
2. Slide the connector onto the conduit until it bottoms up inside the connector. You can feel it hit bottom.

3. Lightly tighten the screw as shown.



4. Hold the conduit with your left hand. With your right hand tighten the screw as shown.

CAUTION: BE SURE to hold your left hand away from the connector so you don't stab your hand with the screwdriver.



METHOD OF EVALUATION:

The instructor will observe the operation in progress.

COMPETENCY: Install Compression-type Conduit Connectors

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install a compression connector according to the N.E.C.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

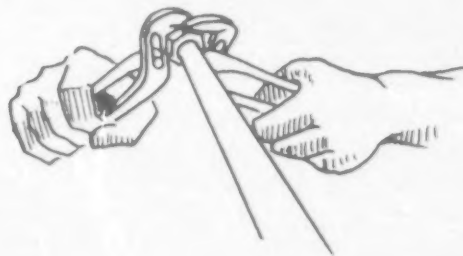
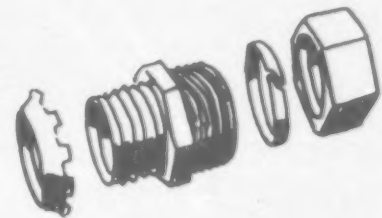
1. Slide the connector onto the conduit until it bottoms up. You will feel it click when it hits bottom.



2. Hold the connector as shown and turn the compressing nut with your finger until it is tight.



3. Place the water pump pliers on the connector and tighten it securely.



METHOD OF EVALUATION:

The instructor will check the finished connections.

COMPETENCY: Hold the Conduit Bender or Hickey

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To hold the bender and the conduit according to the instruction sheet

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Put the bottom of the bender against the ball of your foot and keep a slight downward pressure on the conduit.



2. Lock your knee against the handle.



3. Place your left hand up on the conduit. Always keep a slight downward pressure on the conduit.



METHOD OF EVALUATION:

The instructor will observe.

COMPETENCY: Bend an Offset in Conduit up to 1" in Diameter

COURSE: Electrical Occupations

UNIT II: Wiring Methods

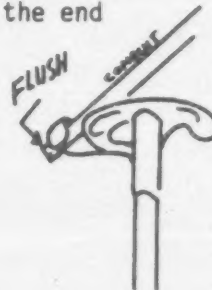
OBJECTIVE: To bend conduit up to 1" offset. Bend must pass N.E.C. standards

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

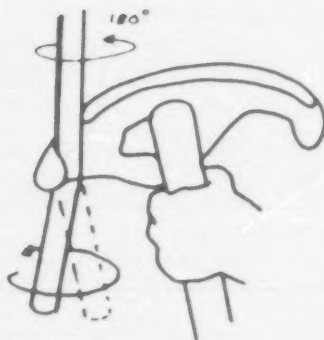
1. Position the conduit in the hickey so the end of the conduit is flush with the end of the hickey.



2. Position your hands as shown and pull downward until the conduit bends slightly.



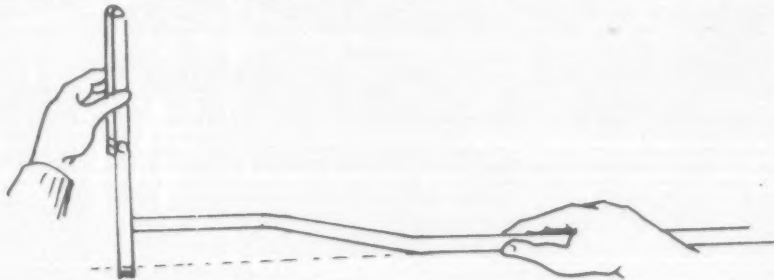
3. Relax the tension and turn the conduit 180° and move the conduit forward until the bend is about 1" ahead of the conduit hickey.



4. Sight down the conduit as shown and rotate the conduit to the left and to the right to make sure that it has been turned 180° .



5. Position your hands as in step 2 and pull downward until the conduit bends the same amount as in step 2.
6. Place the conduit offset on a flat surface and measure from the surface to the bottom of the conduit.



7. The offset may be increased by repeating the above procedure or decreased by reversing the bends and repeating the above procedure.

METHOD OF EVALUATION:

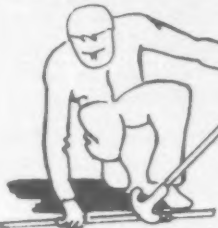
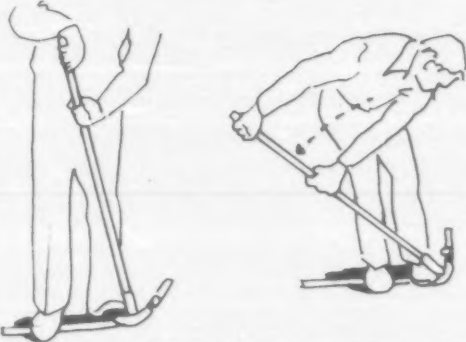
The instructor will observe work in progress as well as finished work.

COMPETENCY: Bend an Exact 90° Stub

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To bend exact 90° stubs, bend must meet N.E.C. standards

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Put the conduit in the hickey on the floor as shown.	
2. Put your feet on the conduit and position your hands on the hickey as shown.	
3. Apply extreme pressure with your left foot on the hickey and pull the handle of the hickey toward you until position A is reached.	
4. Position your hands as shown and keep bending the conduit until a 90° bend is made.	

METHOD OF EVALUATION:

The instructor will inspect the finished bend.

COMPETENCY: Bend a Kick

COURSE: Electrical Occupations

UNIT II: Wiring Methods

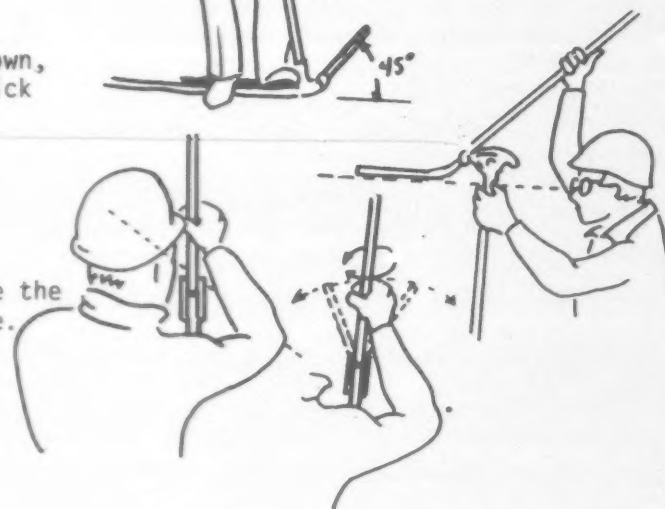
OBJECTIVE: To know how to bend a kick

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Put the conduit in the bender and make a slight bend in the conduit.
2. Put the bender on the floor and bend the conduit to a 45° angle. (You will have a 45° angle when the handle of the bender is straight up.)

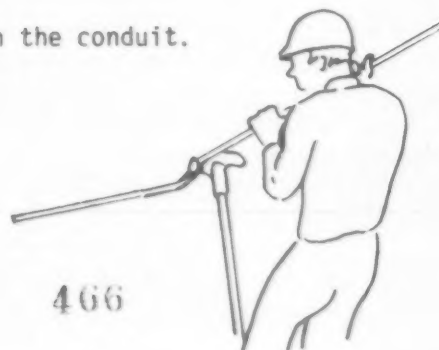


3. Put the conduit in the bender as shown, eye-ball the desired depth of the kick with the inch marks on the bender.

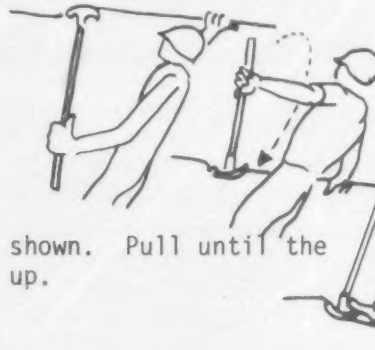


4. Sight down the conduit and make sure the conduit is not cocked to either side.

5. Make another slight bend in the conduit.

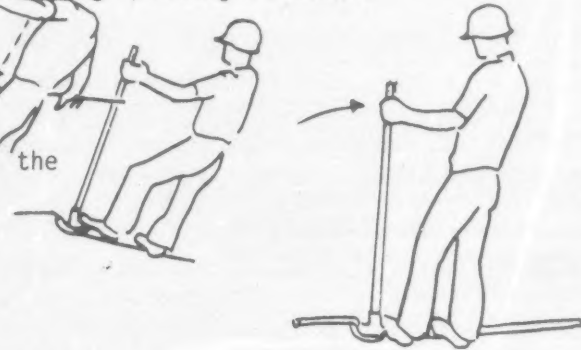


6. Place the conduit on the floor as shown.



NOTE: Make sure it does not slip by keeping tension on the conduit when you are putting it down.

7. Pull the handle as shown. Pull until the handle is straight up.



8. Put the conduit in the bender as shown.



NOTE: At this time you can lengthen or shorten the kick to fit around the object to be kicked.

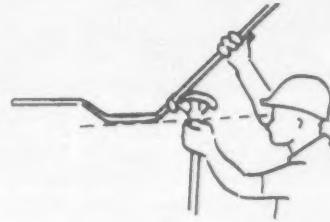
9. Put a slight bend in the conduit as shown.



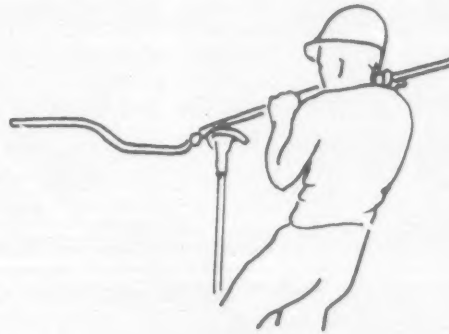
10. Put the bender back on the floor and pull the handle until it is straight up.



11. Place the conduit in the bender as shown. Sight along the conduit and bender as in Step 3. Make sure the conduit is not cocked to either side.



12. Bend the conduit as shown.



13. Place the conduit on the floor again.



14. Pull the handle until it is straight up.



METHOD OF EVALUATION:

The instructor will observe the work in progress and examine the finished bend.

COMPETENCY: Cut Rigid Conduit

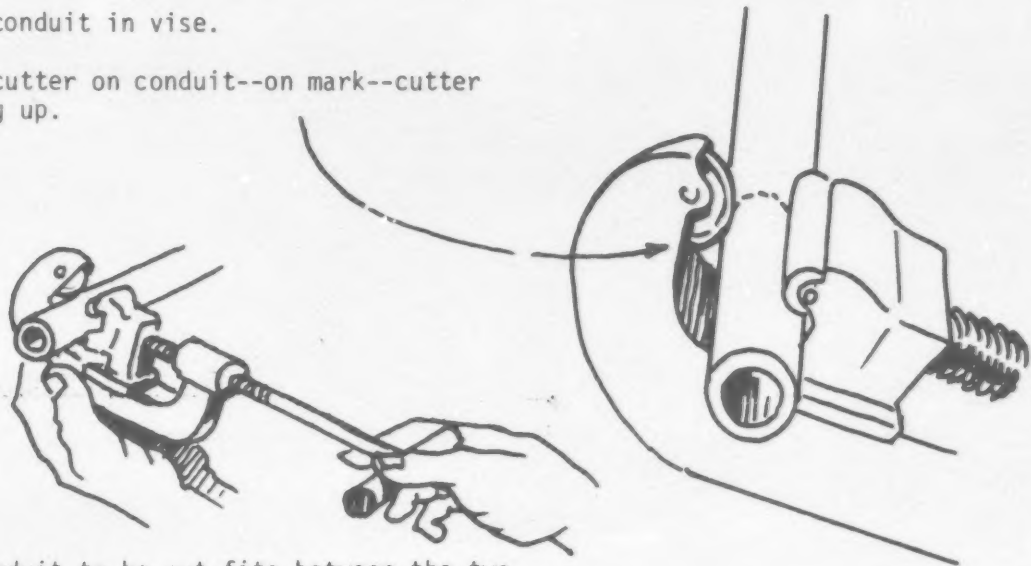
COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To know how to cut conduit

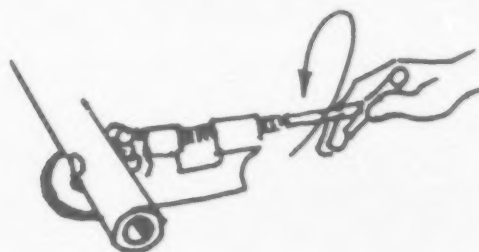
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Place conduit in vise.
2. Place cutter on conduit--on mark--cutter opening up.



3. The conduit to be cut fits between the two rollers and cutting wheel and should be tightened against the conduit for the initial rotating of cutter.
4. The handle on the screw is then tightened 1/4 turn by turning clockwise and the cutter is rotated counterclockwise around the entire conduit.

CAUTION: Do not tighten the handle too tight as it will crack or dull the cutter wheel.



5. After each rotation handle is tightened 1/4 turn clockwise to cut the groove deeper. Cutting oil should be used.
6. The sharp cutting wheel will cut a groove in the outside surface of the conduit, and the groove is made deeper by a continual turning of the handle--until the conduit is cut through.
7. Make sure you have some method of catching the piece that is being cut off.

CAUTION: On short cut-offs, watch your upper arm so it is not cut on the conduit while rotating the cutter.

METHOD OF EVALUATION:

The instructor will observe work in progress as well as inspect the finished job.

COMPETENCY: Ream Rigid Conduit

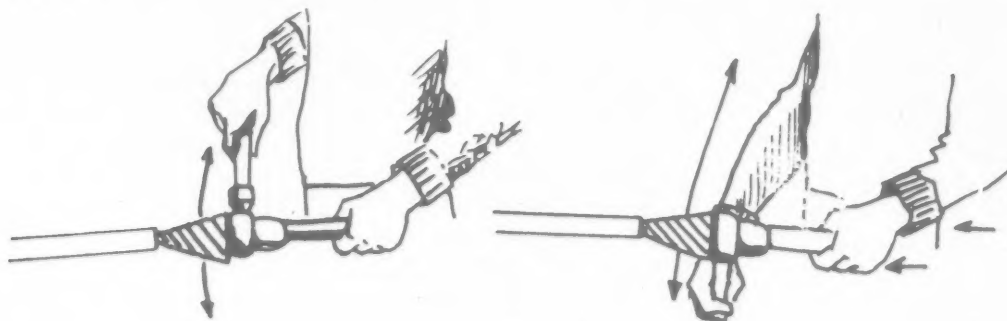
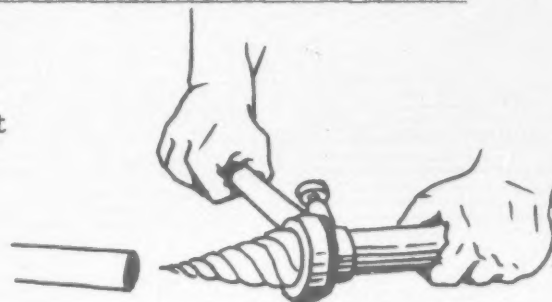
COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To know how to ream conduit

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Hold the reamer as shown.
2. Place the reamer in the end of the conduit and push in on it with your left hand.
3. Push down on the handle of the reamer with your right hand.
4. Ratchet the handle up and down until the burrs are removed from the conduit.
5. Keep rotating the reamer while you remove it so you don't leave a burr caused by the reamer.



METHOD OF EVALUATION:

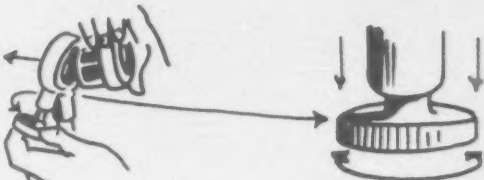
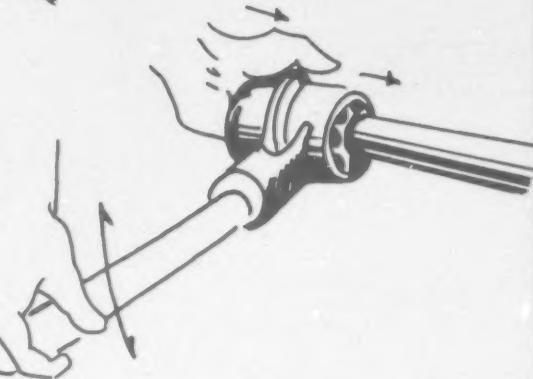
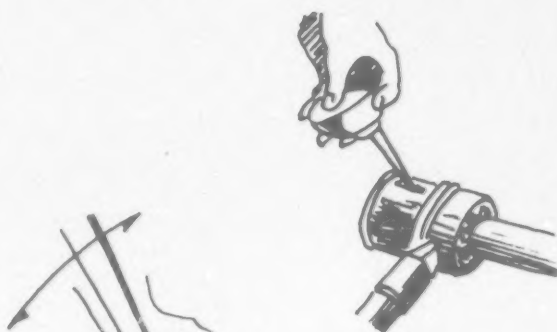
The instructor will observe work in progress as well as inspect the finished job.

COMPETENCY: Thread Rigid Conduit

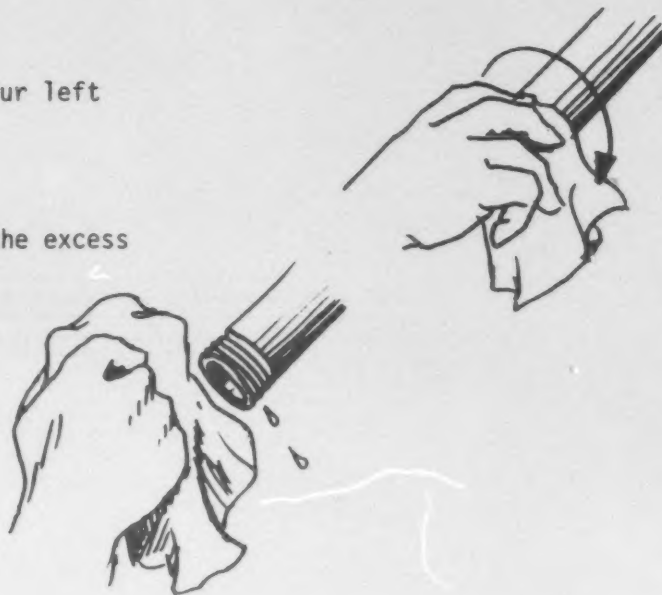
COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To know how to thread a rigid conduit

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Put the pipe to be threaded in a hinged pipe vise with the end sticking out about 6".	
2. Put the right size die into the die holder, and set the die for clockwise cutting.	
3. Hold the die holder in your right hand and slip guide the end of the die over the end of the pipe.	
4. Push on the die holder with your left hand, and turn it clockwise until the die starts cutting thread.	
5. Apply cutting oil to the threading area on every rotation.	
6. Ratchet the die holder in the arc shown.	

7. Cut threads until one thread comes through the die.
8. Re-set the die rotation with your left hand and back the die off.
9. With the wipe cloth, wipe off the excess cutting oil as shown.



METHOD OF EVALUATION:

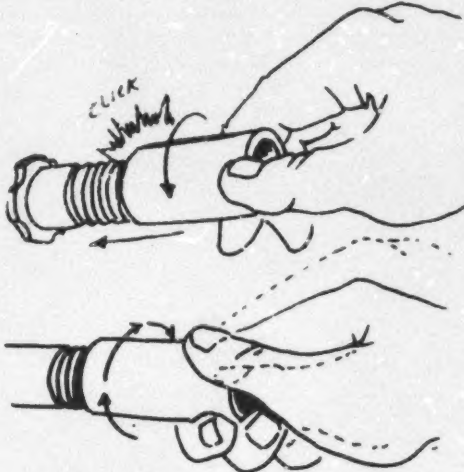
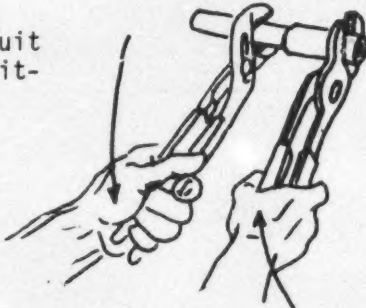
The instructor will observe the finished work.

COMPETENCY: Install Rigid Couplings

COURSE: Electrical Occupations

UNIT II: Wiring Methods

OBJECTIVE: To install the couplings carefully so the fittings are not damaged

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Keep the fitting and the conduit in as straight a line as possible. This lessens the possibility of cross threading. 2. Turn the fitting slowly backward until you feel (and sometimes hear) it click. 3. Turn the fitting forward onto the conduit as tightly as you can with your fingers.	
4. Place one pair of pliers on the conduit as shown and the other pair on the fitting.	
5. Tighten the fitting with the pliers until it is very snug.	NOTE: On this step, be careful not to over-tighten the fitting or you will pull the threads and ruin the fitting.

METHOD OF EVALUATION:

The instructor will observe the work in progress as well as examine the finished job.

COMPETENCY: Alignment

COURSE: Electrical Occupations

UNIT III: Motor Generators

OBJECTIVE: To set two machines and align their shafts so they do not vibrate

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. With one machine on the motor base assemble the four nuts onto the studs loosely. 2. Place the second machine on the base similarly at the opposite end. 3. Insert the rubber coupling. 4. Move the machines together so that the coupling is snug but not tight. 5. Assemble the set screws. 6. Align the machines so that their shafts are in the same vertical plane. 7. Place your finger on the mating metal parts of the coupling and adjust the machines until there is no apparent difference of alignment. 8. Tighten down all nuts. 9. Place the guard over the coupling and bolt down.	NOTE: The two shafts with the mating metal parts must be opposite each other.

METHOD OF EVALUATION:

- The instructor will check for:
1. Following of procedures.
 2. Tolerance of work.
 3. No loose connections.

COMPETENCY: Prony Brake

COURSE: Electrical Occupations

UNIT III: Motor Generators

OBJECTIVE: To install the prony brake and obtain a snug, sliding fit

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mount on the base the required machine.	
2. Remove the half coupling from the machine shaft and assemble onto it the prony brake pulley.	NOTE: Be sure the key is seated and set screws are tight.
3. Mount the prony brake over the pulley and clamp it on the base using the studs for the coupling cover.	NOTE: If the pulley is too tight rub motor shaft, key, and key way with emery cloth to obtain a snug, sliding fit.
4. Pour a small amount of water into the pulley.	
5. With the belt slack start the motor.	
6. The brake is now ready for use.	

METHOD OF EVALUATION:

The instructor will check for:

1. Following of procedures.
2. Tolerance of work.
3. No loose connections.

OPERATION SHEET
SC-3-3

COMPETENCY: Prony Brake Operation

COURSE: Electrical Occupations

UNIT III: Motor Generators

OBJECTIVE: To operate the prony brake

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hang the spring balance from the brake arm by the ring.	
2. Couple the base of the spring to the lug on the base of the brake.	
3. Use two nuts on the screw holding the bottom of the balance so the nut is tight but the balance is loose.	NOTE: If it is too tight the balance will not extend freely and erroneous readings will be obtained.
4. Hang the counter weight on the opposite end of the brake arm.	NOTE: The spring balance must be on the side of the motor shaft to be under tension for the direction of rotation. If this is not so either reverse the direction of rotation of the motor or interchange the spring balance and counter weight.
5. Start motor.	
6. Check that its rotation will produce tension on the balance scale.	
7. Tighten the thumb screw gradually to increase tension on the balance.	
8. Pour water into the hollow pulley.	NOTE: Not too much water or it will splash.
9. Bring the machine up to speed and gradually tighten the brake band to increase the load.	
10. Keep water in the pulley as this will get hot and produce steam.	

METHOD OF EVALUATION:

- The instructor will check for:
1. Following of procedures.
 2. No loose connections.
 3. Attitude toward work.

COMPETENCY: Prony Brake Usage

COURSE: Electrical Occupations

UNIT III: Motor Generators

OBJECTIVE: To determine the horsepower of a motor using a prony brake

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set the tension on the brake band so the dynamometer scale reads 4 or 5 ounces. 2. With a hand-held tachometer measure the motor speed in revolutions per minute. 3. Record the motor current, voltage, speed and force. 4. Repeat the above readings for several settings up to about 10% above the rated current of the machine. 5. Measure the length of the torque arm from the center pivot to point of suspension of the balance. 6. Calculate the horsepower of the machine for each set of readings.	NOTE: Use the formula $\text{Horsepower} = \frac{R \cdot S \cdot F}{33000} \times 2 \pi$ R. = Radius of the torque arm in feet. S. = Motor speed in revolutions per minute. F. = Force on the arm in pounds, as read on the spring scale. 33,000 = Number of foot pounds per minute in one horsepower.

METHOD OF EVALUATION:

The instructor will check:

1. Following of procedures
2. Calculations

COMPETENCY: Using the Tachometer

COURSE: Electrical Occupations

UNIT III: Motor Generators

OBJECTIVE: To use the tachometer

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check the instrument to see the direction of rotation.	
2. Check the dial to find the scale.	
3. Find the correct end for the job you will be doing.	
4. Place the end on the tachometer.	
5. Start the motor.	
6. Check the shaft to see if it has a center hole.	
7. Place in the center hole.	
8. Check rotation.	
9. With stop watch count the revolutions for one minute.	
10. Do this three times.	
11. Find the average.	

METHOD OF EVALUATION:

The instructor will check:

1. Following of procedures
2. Calculations

COMPETENCY: Connect a Starting Rheostat to a D.C. Motor

COURSE: Electrical Occupations

UNIT III: Motor Generators

OBJECTIVE: To gain knowledge of the use of a starting rheostat and how to apply

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect the starter and the D.C. motor.	Under normal operating conditions, the line voltage and the counter EMF differ by a comparatively small amount. At the instant of starting however, the armature is stationary and as a result, there is no counter EMF. If the line voltage were switched directly onto the motor an excessively high armature current would flow.
2. Install the prony brake.	NOTE: The 3-point or 4-point starters are usually used to manually start D.C. motors. They have built-in resistance to limit current through the armature on starting and provides protection of the motor.
3. Turn power on and move starting arm slowly to its operation position.	NOTE: Operation of no load release.
4. Quickly open and close switch SW1.	NOTE: Action of starter.
5. Close switch SW2. Start D.C. motor. Increase load on motor to full load current.	NOTE: The starting box should not be left in service too long or it will burn out.
6. Turn off main power input.	
7. Move starter arm one step at a time and note armature voltage and line current at the beginning and after stabilization of each step.	
8. Turn off power.	

METHOD OF EVALUATION:

The instructor will observe the work throughout and check the finished job.

COMPETENCY: Reverse a D.C. Motor

COURSE: Electrical Occupations

UNIT III: Motor Generators

OBJECTIVE: To reverse a D.C. motor

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Set up a drum switch.
2. Draw your diagram.
3. Check diagram in both positions.
4. Trace out your current.
5. Connect into circuit.

NOTE: In order to reverse a D.C. motor, it is necessary to reverse the direction of current in the field, fields or the armature.

The simplest approach is to consistently reverse direction of the current flow of the rotor.

METHOD OF EVALUATION:

The instructor will check diagrams and finished circuit.

COMPETENCY: Connect a Dynamic Brake to a D.C. Motor

COURSE: Electrical Occupations

UNIT III: Motor Generators

OBJECTIVE: To gain knowledge of the use of the dynamic brake and how to apply it

COMPETENCE - PROCEDURE/STEPS The student will be able to.	TEACHING/LEARNING ACTIVITIES
1. By use of a shunt motor and inertia load, connect a resistance load with a double pole double throw switch.	NOTE: Some operations of motors require a quick stop and need braking action to accomplish this.
2. With no load, position 1, turn motor on. Cut the power and check to see the time it takes to come to a stop.	
3. Turn power on, throw the switch to position 2 and check the time it comes to a stop.	
4. Try this procedure with several loads.	

METHOD OF EVALUATION:

The instructor will check the results obtained.

COMPETENCY: Insert a Field Rheostat in a D.C. Shunt Generator

COURSE: Electrical Occupations

UNIT III: Motor Generators

OBJECTIVE: To gain knowledge in the use of a field rheostat and how to apply

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Make sure you have the field circuit.	
2. Open the circuit or attach to the proper binding post.	NOTE: Is the field rheostat of the right value for the job?
3. Connect to the proper terminal.	NOTE: Should be in series with the field.
4. Make sure you have the rheostat open full.	
5. Then proceed with your steps on the job sheets.	

METHOD OF EVALUATION:

The instructor will:

1. observe to see that procedures are followed correctly.
2. check finished job.

COMPETENCY: Develop a Material List

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To make a complete list of material needed to do the job
acceptable to the instructor's pre-set standard

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Review schematic and/or diagram visually.	REF: Review symbols on D-4-1A, 1B.
2. Make a list of all materials.	Refer to manufacturers' catalogs for trade names of items needed.
3. Check print and material list.	

METHOD OF EVALUATION:

The instructor will review the student's list.

COMPETENCY: Develop and Interpret a Work or Job Sheet

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To explain to the instructor the end result of the job,
acceptable to the pre-set standard of the shop

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Review job or work sheet.	. SC-4-1
2. Explain on paper or verbally operation of job.	Review any information on introduction to motor control circuits in shop theory book.
3. Draw a rough sketch of the circuit.	

METHOD OF EVALUATION:

The instructor will examine the sketch for accuracy and neatness.

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OPERATION SHEET
SC-4-3

COMPETENCY: Select and Inspect Proper Type of Equipment to be Used for Job

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To go to a supply room and select the proper equipment for the job, acceptable to the instructor's evaluation

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Review the job sheet.	. SC-4-1, SC-4-2
2. Make a list of materials.	
3. Checking the nameplates and model numbers select the proper equipment.	Check manufacturers information sheets for equipment use.
4. Using you material list check to see if you have all materials needed.	

METHOD OF EVALUATION:

The instructor will:

1. check materials list.
2. see that you have selected the proper equipment.

COMPETENCY: Layout and Measure Equipment Positions

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To measure and layout the equipment within 1/8 of an inch or to the instructors pre-set standard

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Review schematic and/or diagram visually.	. SC-4-1 through SC-4-3
2. Determine the best layout of equipment.	
3. Make a rough sketch of layout.	
4. Have instructor check rough layout.	

METHOD OF EVALUATION:

The instructor will check the rough layout.

OPERATION SHEET
SC-4-5

COMPETENCY: Fasten Equipment Using Proper Types of Fasteners

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To choose the proper fastener and mount the equipment,
acceptable to the shops good wiring standard

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine the type of fasteners needed.	. SC-4-1 through SC-4-4
2. Determine the number of fasteners needed.	
3. Mount the equipment using the proper fasteners.	NOTE: Use manufacturers catalog to review types and use of various fasteners.

METHOD OF EVALUATION:

The instructor will check to see that the proper fasteners were used.

OPERATION SHEET
SC-4-6

COMPETENCY: Layout Wire Runs

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To layout the various wire runs needed to complete the job,
acceptable to the shops good wiring standard

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Review schematic and/or wiring diagram visually.	. SC-4-1 through SC-4-5
2. Determine the wire layout from each piece of equipment.	
3. Group common runs of wire together.	
4. Check overall layout for completeness.	

METHOD OF EVALUATION:

The instructor will check the finished layout.

COMPETENCY: Select and Measure Proper Wire Size

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To select the proper size wire for the job and measure and cut it to the proper length acceptable to the shop standard and to the N.E. Code

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Review the schematic for the job.	. SC-4-2
2. Using the nameplate or the manufacturers information determine the operating current.	
3. Check National Electric Code or other wire size charts to match wire size and loads.	NOTE: Use National Electrical Code book tables 310-12-13-14-15. Use a wire chart and an American Wire Gage.

METHOD OF EVALUATION:

The instructor will check to see that proper wire size and length is used.

COMPETENCY: Shape and Bend Wire

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To bend and shape the wires together forming the proper wire runs in order for the job to work, acceptable to the shop standards and the N.E.C.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Review schematic and/or diagram.	. SC-4-1, SC-4-6, SC-4-7
2. Determine wire runs.	
3. Bend wire as needed to suit job. (offsets, saddels, and 90° bends)	
4. Lace or tie wires in groups.	

METHOD OF EVALUATION:

The instructor will inspect the wire runs.

COMPETENCY: Make Proper Electrical Connections

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To make various electrical connections using soldering, pressure terminals and eyes, acceptable to the shop standards and to the N.E.C.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine the type of connection needed.	NOTE: Using catalogs on wire connectors check various styles and types available.
2. Skin and prepare wires.	
3. Solder where needed.	Review information on soldering (types of irons, solder, flux)
4. Select proper pressure terminal and crimp it to the stranded wire.	
5. Using shop hand tools and solid wire make various sizes of eyes.	

METHOD OF EVALUATION:

The instructor will check the finished wire connections.

COMPETENCY: Make and Tape Proper Types of Splices

COURSE: Electrical Occupations

UNIT IV: Motor Control

OBJECTIVE: To make various types of splices and tape them according to the shop standard and the N.E.C.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine the type of splice needed. 2. Prepare wire for splicing. 3. Splice the wire using various types of splices: a. Pigtail b. Single Tee c. Double Tee	NOTE: Review the various types of splices used and how each is made. Review alternate methods of reinsulating.

METHOD OF EVALUATION:

The instructor will check the finished splices.

OPERATION SHEET
SC-4-11

COMPETENCY: Check Complete System by the Schematic Diagram

COURSE: Electrical Occupation

UNIT IV: Motor Control

OBJECTIVE: To completely check the job following each wire to its termination point, acceptable to the shop standard

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Look over and inspect job visually.	. SC-4-2
2. Check each wire and its termination point against the schematic.	NOTE: Circuit can be checked using an ohmeter.

METHOD OF EVALUATION:

The instructor will observe the student's work.

OPERATION SHEET
SC-5-1

COMPETENCY: Test a Circuit with a Trouble Lite

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To find fault in a circuit using a lamp

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Make sure your test lamp is good.	
2. Safety - Be careful when inserting the tester not to touch your metal box.	
3. Place the two leads across the supply voltage.	
4. Check further into the circuit.	
5. Where the voltage is not present, look for an open circuit.	

METHOD OF EVALUATION:

1. Checking the test lamp.
2. Inserting the leads to check the voltage.
3. Checking the students' understanding of what they see.

COMPETENCY: Test a Circuit with a Voltmeter

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To find fault in a circuit using a voltmeter

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Make sure the meter is in working order.	
2. Check to see if meter is at the highest voltage scale.	
3. Check supply voltage.	
4. If not the correct scale, change scale on meter.	
5. Proceed to check each device.	
6. If voltage is present then the device is open.	

METHOD OF EVALUATION:

1. Checking the students knowledge of the meter and that they can read the corrected scale.
2. Checking the meter.
3. Checking the placement of the leads.

OPERATION SHEET
SC-5-3

COMPETENCY: Test a Circuit with an Ohmmeter

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To find a faulty device with an ohmmeter

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Make sure no source voltage is present.	
2. Check meter to see if it is okay.	
3. Proceed to measure each device making sure there is nothing else on the line.	

METHOD OF EVALUATION:

1. Students being able to read the instruction to operate the meter.
2. Checking to see that the students disconnect the device from the line.
3. Checking meter to see if it is reading correctly.
4. Checking the students' ability to record the readings of each device and that they locate the fault.

OPERATION SHEET
SC-5-4

COMPETENCY: Use a Clamp-type Volt-Ammeter in a Service Installation

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: Checking a service for load with a clamp-type volt-meter

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Make sure the meter is working.	
2. Have a full load on service.	
3. When using clamp be careful of open conductors - clamp the one line.	
4. Measure the load.	
5. Clamp the other line.	
6. Measure the load.	
7. Clamp the identified conductor.	
8. Read the meter.	
9. Turn off all devices.	
10. Repeat to see if you have any leaks.	

METHOD OF EVALUATION:

1. They know all the instruction with the meter.
2. They are careful when working the circuit.
3. They record all readings.
4. They double check all results.

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OPERATION SHEET
SC-5-5

COMPETENCY: Use a Clamp-type Volt-Ammeter in a Motor Installation

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To use the clamp-type meter

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check the meter to see if it is okay.	
2. Starting at the source, check each line as motor is operating.	
3. Check at the motor each line.	
4. Check when the motor is first turned on - using the peak load button to give peak amps.	

METHOD OF EVALUATION:

1. Make sure they check meter for correct scale.
2. Check all readings.
3. They are careful when checking.

COMPETENCY: Troubleshoot a Relay with a Clamp-type Volt-Ammeter

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To familiarize with relays

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Secure relay (cut electrical source).	
2. Check to see if contacts are frozen.	
3. Check to see if the mechanism will operate (manually with excessive force).	
4. Check for improper calibration (trip too fast or too slow).	
5. After inspection, if no other visual is indicated apply voltage.	
6. Check with meter values determine if coils are operative.	

METHOD OF EVALUATION:

1. See if they examine the relay without power.
2. Check to see if they make the readings.

COMPETENCY: Measure Insulation Quality using an Insulation Tester

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To correctly use a megger

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Secure the megger - check on operation, read instruction.	
2. Make sure of your equipment rating.	
3. Disconnect completely from power source.	
4. Check your instrument for accuracy.	
5. Remember, as connections are made turn the handle at an even speed for each test for one minute.	
6. Temperature and humidity have a profound effect on the test, they are recorded immediately after the test (there is a chart to help interpret the readings).	
7. Check for infinite readings (the test leads not connected).	
8. Check for zero reading (short the test leads).	
9. Check insulation readings from conductor to ground (line test lead to conductor and earth test lead to ground).	
10. As use of this test along with a chart kept on each apparatus, you will be able to tell if the insulation is breaking down.	

METHOD OF EVALUATION:

1. Make sure they read the directions.
2. See that they check the megger.
3. Make sure they double check their readings.
4. They also must check the temperature.

COMPETENCY: Check an Armature with a Growler

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To correctly use a growler

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check the growler to see if it is in working order.	
2. Place armature on growler.	
3. Turn on growler.	
4. Check with hack saw blade.	
5. Turn armature slowly.	
6. If hack saw blade is attracted you have found the shorted coil, mark with chalk.	
7. Find the other slot so you can double check coil shorted.	
8. With the use of the growler you can check for grounded coils.	
9. Also check for voltage across the bars.	

METHOD OF EVALUATION:

1. Locating the short.
2. How they read and adjust the volt-meter on growler.

COMPETENCY: Check a Stator with a Growler

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To know the use of an inside growler

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check the internal growler.	
2. Take stator.	
3. Turn on growler.	
4. Check with hack saw blade.	
5. Find shorted coil same as you would with an armature.	
6. Mark with chalk.	

METHOD OF EVALUATION:

1. Locating the short.
2. Double check for ground.

COMPETENCY: Use a Tachometer on a Motor

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To correctly use a tachometer

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check name plate of motor.	
2. Observe the drive end of motor.	
3. Turn motor on.	
4. Place tachometer on shaft.	
5. Time for one minute.	
6. Observe the R.P.M.	

METHOD OF EVALUATION:

1. Watch them observe the correct direction.
2. Make sure they observe for the minute.

COMPETENCY: Check a Motor with a Vibration Indicator

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To properly use a vibration indicator

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	
1. With motor operating: 2. Place the indicator on the one end - check vibrations. 3. Place the indicator on the other end, check vibration. 4. If motor is driving on other type of equipment, place indicators on the equipment check. 5. Due to making a chart for each time check, you can trace out excess vibration and locate the bad bearing.	

METHOD OF EVALUATION:

1. Check for variations of readings.
2. How they hold the indicator.

COMPETENCY: Set-up a Wheatstone Bridge and find the Distance to a Fault
in a Phone Line

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To correctly use a wheatstone bridge

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Check bridge to be sure it is true.
2. Pick up a treated cable with a false break.
3. Set up the bridge as per instruction.
4. Operate the bridge, make readings and solve.

METHOD OF EVALUATION:

1. Make sure they know how to place wheatstone in circuit.
2. Check their calculations.

COMPETENCY: Set-up a Recorder on an Electrical Circuit

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To properly use a recorder meter

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check meter to see if it is working.	
2. Place in circuit of the job.	
3. Start tape - record for one hour.	
4. Take instrument off - check the tape.	

METHOD OF EVALUATION:

1. See if they read instruction of meter.
2. Placement of meter in circuit correctly.
3. Check the readings of the tape.

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COMPETENCY: Check for adequate Illumination with a Foot-Candle Meter

COURSE: Electrical Occupations

UNIT V: Electrical Maintenance

OBJECTIVE: To properly use a foot-candle meter

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check meter to see if it is operating.	
2. Find the foot-candles, located on each surface of the shop.	
3. Record - check with table to see if they require foot-candles and are equal.	

METHOD OF EVALUATION:

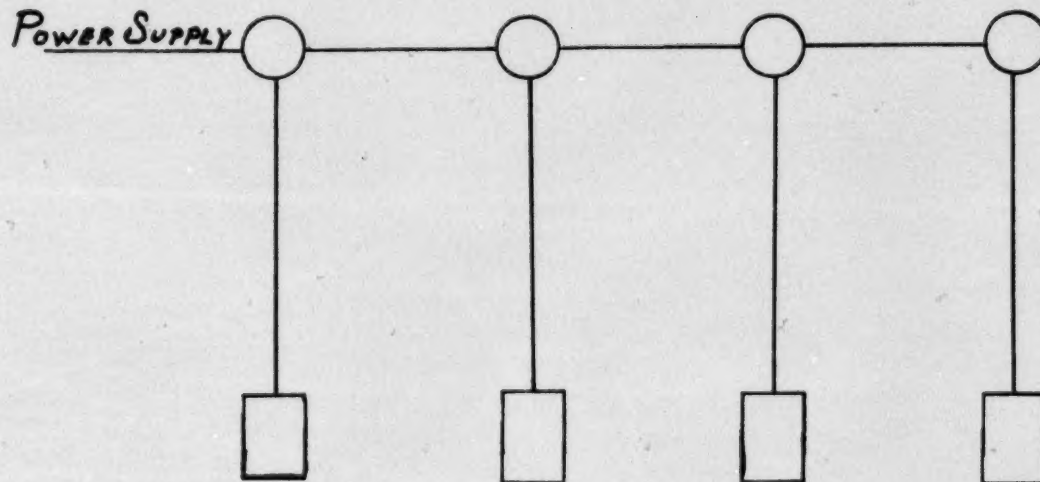
1. Check to see if they read instruction on meter.
2. The recording of each location.

TITLE: Circuits Used with Single Pole Switches, 4 Lights, 4 Switches,
Each Controlled by its Own Switch, All on the Same Circuit

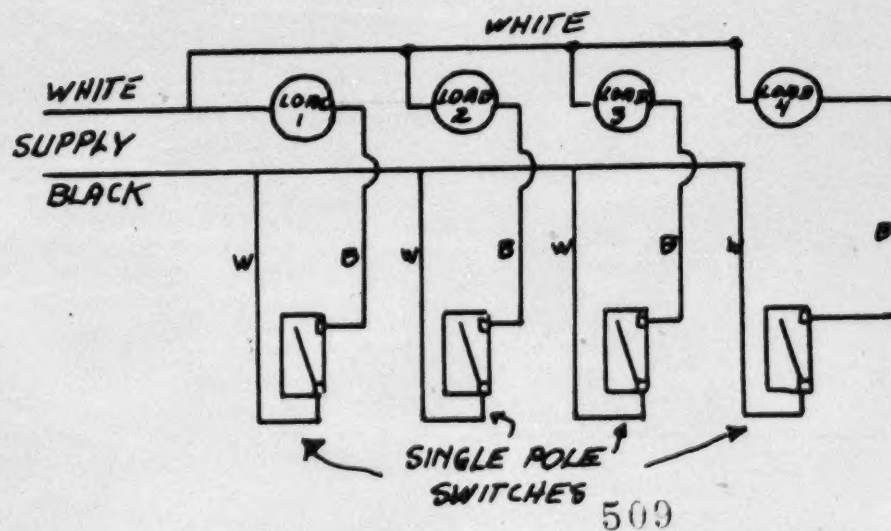
COURSE: Electrical, General

UNIT II: Wiring Methods

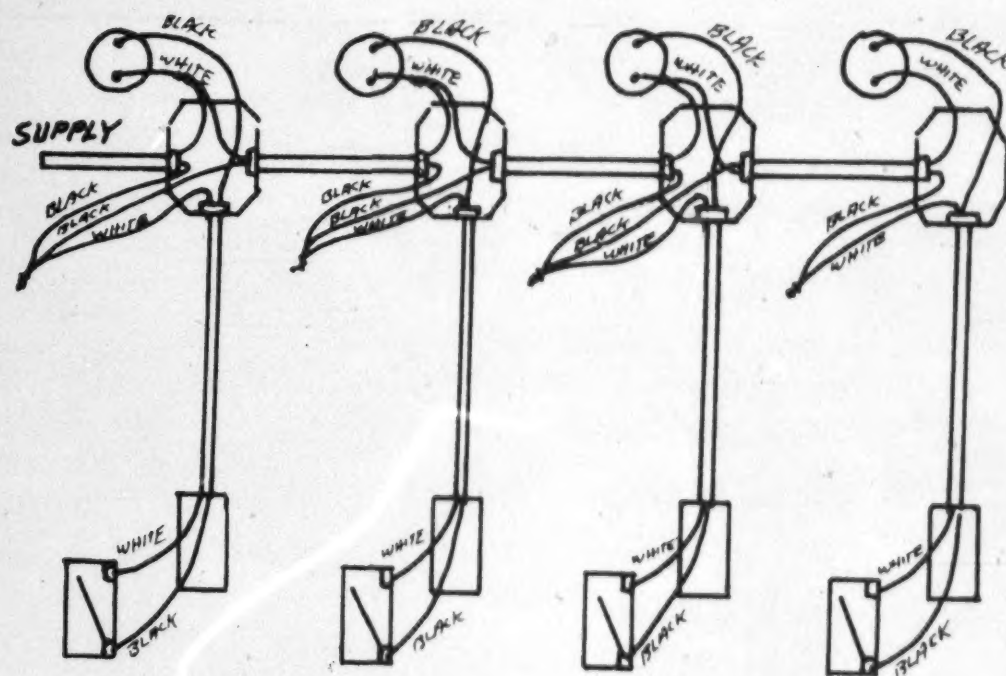
Many times the electrician may have the need to put several loads or lights on the same circuit. However, each load should be controlled from its own switch.



Shown below is a line diagram for the hook up. More loads can be added or loads can be taken off.



This drawing shows how the actual hook up will be.



Note: MINIMUM LENGTH OF LEAD
EXTENDING FROM ANY BOX IS 8"

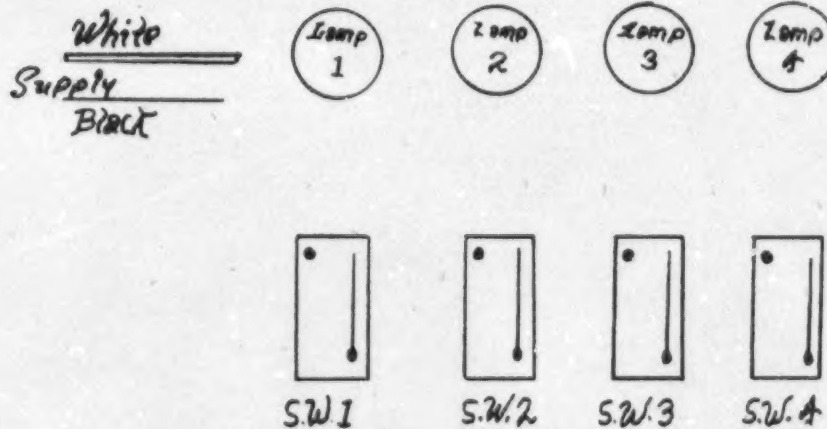
TITLE: Hook Up a Single Pole Switch

COURSE: Electrical, General

TEXT/REFERENCE:

ASSIGNMENT:

1. Below is the drawing of four lamps and four single pole switches with only one supply voltage. With a pencil, draw in the wires so that #1 switch controls #1 lamp, and #2 switch controls #2 lamp, and #3 switch controls #3 lamp, and #4 switch controls #4 lamp.



2. With a pencil, draw the wires to show the actual hook up.

